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A morphological and taxonomic study of the nearctic species of the moth genus Apotomis Hbn. (Lepidoptera-tortricidae).

David Adamski
University of Massachusetts Amherst

A MORPHOLOGICAL AND TAXONOMIC STUDY OF THE NEARCTIC SPECIES OF THE MOTH GENUS APOTOMIS HBN. [LEPIDOPTERA-TORTRICIDAE]

A Thesis Presented

By

DAVID ADAMSKI

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University of Massachusetts in partial fulfillment
of the requirements for the degree of

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Entomology Department

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Also a special thanks to my advisor for taking me on to study this problem.

ABSTRACT

The external morphology of adult Apotomis Hbn. (Tortricidae - Lepidoptera) is presented in Chapter II and is based on A. albeolana (Zeller) as a "typical" species. Electron micrographs illustrate chaetosema, ocelli, compound eyes, and galeal sensilla. Head, thorax and abdomen are illustrated and labelled. Highlights of text include cibarial musculature, pronotal structure, discovery of a new axillary sclerite (axillary I_A) in the base of the hindwing, and description of male and female genitalia.

A revision of Nearctic species of the moth genus Apotomis Hbn. (Tortricidae- Lepidoptera), is presented in Chapter III and based on examination of museum specimens. Seventeen species, of which the following three are new, are recognized: Apotomis coloradensis, A. spurinfida and A. trifida. All male and female genitalia are illustrated. Genitalia of male and female A. paludicolana (Brower) are described and illustrated for the first time. Genitalia of previously unknown specimens of female A. tertiana (Heinrich) are described and illustrated. Females of A. albeolana (Zeller), A. capreana (Hubner), A. removana (Kearfott), and A. funerea (Meyrick) are redescribed due to inaccurate illustrations in Heinrich (1923, 26). A historical review of the genus is presented. A generalized forewing

pattern modified from Bradley, Tremenan & Smith (1973) is labeled and illustrated.

A key to males and their associated females is presented in conjunction with illustrations of key characters. Photographs of new species are presented.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

C H A P T E R I

INTRODUCTION

The lepidopterous family Tortricidae is a cosmopolitan group composed of 4 subfamilies totaling approximately 3,800 species. They are perhaps best known because of the many pest species (ex. codling moth, grape berry moth, red banded leafroller, etc.) whose larvae feed as leafrollers, leaf webbers, and borers in stems, roots or seeds.

In a forthcoming checklist (Powell, in press) the subfamilies Olethreutinae, Tortricinae, and Chlidanotinae are recognized as constituting the North American Tortricid fauna. Within the nearctic region the vast majority of the approximately 1,000 species known are placed in the Olethreutinae. Olethreutine larvae have been restricted host preferences, feeding largely on dicotyledonous and coniferous plants.

Species within the olethreutine genus Apotomis are considered to be solitary feeders, living as leaf-folders or tiers on members of the Betulaceae and Salicaceae. They are known to occur throughout the nearctic region except for southeastern United States.

The study presented here has dealt with several problems in determining the species identity of specimens

within Apotomis. These include: small size, extensive wing pattern polymorphism, and the lack of distinguishing wing pattern characteristics, all of which dictate the dissection and examination of male as well as female genitalia.

The strategy of studying the morphology of a familiar species (A. albeolana) and comparing other phena for differences and similarities was employed. The morphological study is presented in a separate paper.

It should be noted here that sibling-species have not been detected by this study. Perhaps when more is known about the Olethreutinae ecologically and behaviorally, the possibility of extant sibling species groups may be investigated.

C H A P T E R I I

EXTERNAL MORPHOLOGY OF *APOTOMIS ALBEOLANA* (ZELLER) (LEPIDOPTERA-TORTRICIDAE)

Introduction

This study has been undertaken as a preliminary step toward a forthcoming taxonomic revision of the nearctic moth genus *Apotomis* Hbn. (Tortricidae-lepidoptera).

Comparative morphological studies within the Olethreutinae have been limited. These include Freeman (1947), Brock (1971), and Brown (1980 Ph.D. dissertation). Since the morphology of the olethreutine moths is not well understood, we anticipate that the study presented here will contribute to a better understanding of the subfamily, of the Tortricidae, and of Lepidoptera in general.

Materials and Methods

Since *A. albeolana* was more commonly collected than its congeners in Massachusetts, we chose it as a "typical" representative for study of the genus *Apotomis* Hbn. Light trap material was supplemented with pinned museum specimens.

Specimens were bleached in 0.5% NaOCl cleared in 10% KOH, dehydrated with ethyl alcohol, and examined in glycerine. Methods and equipment used for study of structures and are summarized in Table 1.

Table I. Summary of methods and equipment used

Structure	Method	Equipment
Organ of van Rath Internal musculature of head	Dissection	Stereoscopic dissecting microscope
Chaetosema Ocellus Compound eye Ommatidial hairs Proboscis	SEM	Etec Autoscan (SEM)
Wing venation Antennae Legs	Bleaching Method (Borror, DeLong, and Triplehorn 1976) Mallory's triple stain & mounted in balsam	Stereoscopic dissecting microscope
Wing articulation	Mallory's triple stain glycerine mount	Steroscopic dissecting mocroscope Interference-contrast microscope
Genitalia	Mercurochrome stain glycerine	Stereoscopic dissecting microscope Interference-contrast microscope

External morphological structures are illustrated and labelled. Morphological structures not differing significantly from the generalized condition are labelled but not discussed in the text.

Results and Discussion

Head. Head hypognathus (Figs. 1, 2), superficially simple, with few visible sutures, dominated by compound eyes. Fronto-clypeus, most prominent of all anterior sclerites of head capsule; broad, slightly convex, laterally bounded by ocular sutures, extending dorsoventrally from margins of antennal sockets down to its ventral margins, moderately overlapping bases of mouthparts.

Subgena subtriangular, delimited by lateral margins of fronto-clypeus, subgenal and ocular sutures. Rudimentary mandible represented by finger-like lobe beneath each anterior tentorial pit. Pair of clearly discernible depressions visible in frontal view of subgenal area mark invaginations of anterior arms of tentorium. According to Snodgrass (1935), anterior tentorial pits occur on epistomal or subgenal sutures, in either case providing landmark for point of division between frons and clypeus. However, dissections of specimens of A. albeolana agree with Madden's (1944) study of Manduca sexta indicating principle dilator muscles of cibarium arise above point. Since Snodgrass (1935) claims these muscles originate from clypeus, we

concur with Madden that it (clypeus) forms a larger portion of frontal region than indicated by position of anterior tentorial pits and associated sutures. Thus clypeal region extends somewhat dorsad from straight line drawn between anterior tentorial pits on fronto-clypeal surface.

Compound eyes globose, projecting laterally beyond contours of head capsule; delimited by ocular sclerite and suture. Compound eyes appear naked under low magnification, however, SEM analysis indicates sparse coverage of minute ommatidial hairs between facets. Compound eyes apparently supplanted development of subgenal and genal areas.

Antennal sclerite encircles each antennal socket, demarked by antennal suture. Antennifer, median extension of antennal sclerite, articulates with base of scape. Scape is largest antennal segment, articulates distally with pedicel. In A. albeolana, male flagellum consists of 45 to 49 flagellomeres, (N=4); 47 to 49 (N=4) in female. Male flagellum more ciliate than female.

Vertex large, convex; bilaterally bearing antenna, ocellus and chaetosema cluster (Fig. 3). Posterior region of head capsule dominated by postgenae; median extensions fuse with posterior arms of tentorium, horizontally dividing occipital foramen. Postgenae separated from occiput by postgenal sutures. Postocciput narrow, encircling occipital foramen (dorsal) and bounded by occipital suture. Snodgrass (1935) claims it forms internal postoccipital ridge.

Occipital condyles between posterior tentorial pits; articulate with lateral sclerites of cervix. Median stem between condyles probably serves as point of muscle attachment assisting in vertical movements of head capsule.

Labrum narrow, transverse, partially concealed by ventral margins of fronto-clypeus. Pilifer on each lateral margin of epipharnyx. Function unknown. Labium flexible; bearing 3 segmented palps; basal and medial segments ascending, terminal segment porrect and bearing organ of van Rath (in both sexes); post labium narrow; bears scale sockets. Maxillae prominent, 3 segmented. Cardo and stipes concelaed within oral cavity by ventrolateral extensions of subgena. Cardo articulates with invaginated subgenal ridge. Maxillary palps 3 segmented. Each galea possesses two rows of sensilla, each approximately .05mm long, probably chemoreceptors (Fig. 4).

Cervix. Predominantly membranous; paired cervical sclerites (Fig. 5) inverted "T-shaped", each form 3 points of articulation; cephalic articulation at juncture of medial stem and occipital condyles, ventral articulation between ental branch and dorsoanterior apices of $sternum_1$, and lateral articulation between ectal branch and ental margins of prothoracic collar. Ligaments bind each articulation.

Thorax and Its Appendages. Prothorax (Fig. 5, 6), smallest thoracic segment, composed of prothoracic collar and pronotum. According to Matsuda (1970) the prothoracic collar in Lepidoptera is a fusion of $anepisternum_1$, $katepisternum_1$ and $sternum_1$. The latter fuses with $basisternum_1$. $Basisternum_1$ bifurcate, extends dorsally to $spinasternum_2$ both bissecting prothoracic coxae.

Pronotum composed of three sclerties. Anterior pronotal sclerite "I-shaped"; fused to dorsal apices of median bridge. Median bridge may be homologous with Matsuda's (1970) lateral plate; functions as dorsomedian support of collar. Posterior pronotal sclerite "Y-shaped"; stem fuses with ventral extensions of $prescutum_2$; lateral branches extend to anterior pronotal sclerite. Anterior and posterior pronotal sclerites may be homologous to Matsuda's (1970) dorsal plate. Patagia squamiform, semi-ovate; fuse with dorsal margin of median bridge and propleuron.

Mesothorax (Figs. 6, 8, 9), largest of thoracic segments; dominated by $scutum_2$; divided dorsally by median longitudinal suture. $Scutum_2$ extends ventrally from anterior angles, forming prealar arms, fused to dorsoanterior margins of $episternum_2$. $Prescutum_2$ narrow, fused with anterior margin of $scutum_2$; not visible from dorsal view

due to overlap of latter.

Scutellum$_2$ "V-shaped", convex, fused with posterior margins of scutum$_2$; lateral margins developed into axillary cord. Postscutellum posterior to alinotum$_2$; narrow, partially concealed within depressions between scutum$_2$ and scutellum$_2$.

Tegulae, a lepidopteran characteristic (Matsuda 1970), are lunate plates, posterior to spiracle$_2$, extending dorsoventrally over anterior portion of scutum$_2$. Ventral portion of tegula supported by subtegula tergopleural apodeme (latter not illustrated). Subtegula situated between prealar arm and anepisternum$_2$.

Mesopleuron divided by pleural ridge and pleural suture; latter extends dorsally to pleural process. Anepisternum$_2$ and katepisternum$_2$ anterior to ridge; both posterior to parepisternum$_2$, (Brock 1971, = preepisternum$_2$ of Shepard 1930). Parepisternum$_2$ partially separated from anepisternum$_2$ by anapleural suture and membranous cleft. Epimeron$_2$, posterior element of mesopleuron forms posterior support of notum$_2$, extends dorsoanteriorly to form pleural process.

Ventral margins of katepisternum$_2$ fuse with lateral extensions of basisternum$_2$. Basisternum$_2$ fuses anteriorly with acrosternite, posteriorly with furcasternum$_2$.

Episternum$_3$ extends dorsoanteriorly into a process

behind spiracle$_3$ and ventrad to basalare. This process may be homologous to Freeman's (1947) basalare pad. Epimeron$_3$ extends dorsoanteriorly forming pleural process, flanked by basalare (anterior) and subalare (posterior). Subalare weakly fused to base of pleural process and scutum$_3$.

Scutum$_3$ (Figs. 6, 8) "hour-glass shaped", overlaid posteriorly by scutellum$_3$. Scutellum$_3$ "C-shaped", lateral margins produced into membranous axillary cord. Prescutum$_3$ appears vestigal. Post-scutellum$_3$ posterior to scutellum$_3$, deeply invaginated and associated with large phragma. Anterior portion of abdominal tergite$_1$ articulates with posterior margin of postscutellum$_3$. Basisternum$_3$ (Fig. 9) inwardly keeled like basisternum$_2$, representing midventral line; fused posteriorly with furcasternum$_3$.

Wings and Wing Articulation. Forewing (Fig. 10) alar expanse: male 7.16-8.33mm, (N-25), female 7.26-8.76mm, (N=25). Superficially rectangular; complement of 13 veins including costa. Venation follows Mackerras (1970). CuP atrophied, 3A lost; chorda and media contained in cell. Males possess small elliptical reticulation above anal margin at base.

Hindwing (Fig. 11): radials + CuP reduced, discal cell open, and cubital pecten present. Males possess anal fold on inner margin, containing androconia scales.

Forewing and hindwing coupled by bristle-like frenulum; simply in male, inserts into retinaculum (Kuznetsov 1919). Retinaculum unciform, situated on ventral surface of forewing at base of Sc vein. Frenulum complex in female, received by cteniolum (Kuznetsov 1919); comblike, situated on ventral surface of forewing at base of cubitus.

Axillary$_1$ (Fig. 12) of forewing forms anterior hinge; a detached piece of median lateral notum (Sharplin 1963a). Shape irregular, broad at base, developed anteriorly into "neck" and laterally into median arm. Neck articulates with basisubcostale and humeral plate; median arm with axillary$_2$.

Axillary$_2$ is fulcrum of wing base. According to Sharplin (1963a), "The second axillary sclerite typically extends through the thickness of the wing base from the dorsal to the ventral wing membrane . . . in all Lepidoptera except the Hepialoidea the original second axillary sclerite is in two parts (dorsally and ventrally situated) which are completely separate or joined by very thin cuticle." Dorsal and ventral components of Axillary$_2$ in A. albeolana are attached by thin cuticle.

Dorsal axillary$_2$ articulates with median arm of axillary$_1$ and proximal medial plate. Ventral axillary$_2$ connected to subalare and pleural process by ligaments.

Axillary$_3$ "Y-shaped", forms posterior wing hinge;

articulates with posterior notal wing process. Connected to proximal median plate via bending cuticle. Flexor muscle originates from pleural ridge, inserts into base of $axillary_3$. Distal median plate articulates with basi-subcostale and expanded base of radius. Plica basalis lies between median plates.

Forewing and hindwing bases generally conform to early investigations (Comstock and Needham 1898-99, Berlese 1909, Crampton 1909, 1920, Snodgrass 1909, 1935). Differences exhibited between these areas are illustrated (Figs. 12, 13) and summarized (Table 2). Except for $axillary_{1A}$, our findings agree with Sharplin (1963a, 1963b). A forthcoming paper discusses Apotomis $axillary_{1A}$ structure and evolution (Adamski and Peters, in press).

Legs (Figs. 14, 15, 16). $Coxa_1$ somewhat elongate, laterally flattened, broad at base tapering toward distal apices; articulates with $trochanter_1$. $Coxa_2$ dorsally fused to $trochantin_2$, ventrally to caudal apices of $furcasternum_2$. $Coxa_3$ similarly fused. Movement of pterothoracic coxae restricted by such fusions. Basicoxal suture subdivides pterothoracic coxae into prearticular lobe (=coxa genuina, Snodgrass 1935) and post-articular lobe (=meron).

All thoracic trochanters irregular cycloids; each

Table II. Summary of structural differences between forewing and hindwing base of Tortricidae (Lep.).

Structure	Fore Wing	Hind Wing
Median arm of Axillary$_1$	Present (well developed)	Absent
Cubital Plates	Absent	Present
Median Plates	Present (well developed)	Present(reduced)
Radial Bridge	Absent	Present
Axillary$_2$	Complex	Simple
Axillary$_{1A}$	Absent	Present

articulates with distal apex of coxa and proximal apex of femur.

Pterothoracic femora of approximately equal length; $femur_1$ slightly shorter. All thoracic femora possess convex posterior margin. Anterior margin of pterothoracic femora possess convex posterior margin. Anterior margin of pterothoracic femora linear; $femur_1$ strongly convex.

$Tibia_1$ short, bearing comb-like epiphysis which articulates within depression between ventral margins of base. Epiphysis functions in grooming antennae and proboscis. $Tibia_2$ twice length of $tibia_1$; slender, broadens distally. Bears pair of apical spurs. Ental spur approximately twice length of counterpart.

$Tibia_3$ approximately 3 times length of $tibia_1$; bearing pair of apical and medial spurs. Male possesses hair pencil cluster on outer margin of proximal apices. Functions to emit scent (Razowski 1976).

Tarsus with 5 tarsomeres. Basal tarsomere approximately equal to total length of apical 4. Pretarsus (Fig. 17) bears 2 lateral ungues with arolium between. Median spine above arolium. Ungues articulate with unguifer; latter structure is a distal process of $tarsomere_5$. Pair of squamiform paronychia connect ventrally to base of unguitractor plate. According to Snodgrass (1935), muscular tension on unguitractor apodeme makes pretarsus functional.

Abdomen and Genitalia. Abdomen (Figs. 7, 18) 10 segmented; genitalia formed by last 2 segments in male, last 3 in female (Kuznetsov 1919, Bierne 1942, Rakshpal 1944, Bentinck and Diakonoff 1968). Abdominal terga and sterna separated by membranous pleura; segments 1 through 7 each bear a pair of spiracles.

Abdominal segment$_1$ more complex than those immediately following. Tergum$_1$ greatly reduced, margins strongly sclerotized; fused anteriorly with posterior margins of postscutellum$_3$ forming tergopleural groove. Sterna$_{1+2}$ angled upward, constricting abdomen.

Tergum$_8$ of male in 2 parts; tergum$_9$ of male (Figs. 18, 19, 20) dome-like, covering aedeagus. Paired socii "foot-shaped", setose; laterally flanking anus; considered part of tergum$_9$ (Kuznetsov 1919, Razowski 1976). Vinculum derived from Sternum$_9$, forming a "U-shaped" ring; connected to ventral margin of juxta by membrane. Valvulae elongate, derived in part from styli, coxites, or parameres of ninth segment, (Kuznetsov 1919, Klots 1970). Sacculus, strongly sclerotized base of valvula, articulates with bases of: juxta, vinculum, and tergum$_9$; Costa is strongly sclerotized dorsal edge of valvula. Cucullus, distal part of valvula, ventral margin covered with setae which increase in length distally.

Juxta "diamond-shaped", fused to caulis (=stem).

Caulis extends dorsally fusing with sclerotized portion of aedeagus. All form olethreutoid complex (Razowski 1976). Cornutus always present, attached to vesica within aedeagus. Uncus well developed, setose; derived from $tergum_{10}$, (Kuznetsov 1919, Klots 1970, Razowski 1976).

Gnathos, a thin, weakly sclertoized bridge fused laterally to posterior margins of $sternum_9$ and dorsally to subscaphium. Subscaphium is sclerotized portion of tuba analis. Gnathos and subscaphium derived from $sternum_{10}$, (Kuznetsov 1919, Razowski 1976).

Female genitalia of typical ditrysian type (Figs. 7, 21, 22). $Tergum_8$ "saddle-shaped", produced posteriorly into anterior apophyses extending into the body cavity. Apophyses function as point for muscle attachment (Kuznetsov 1919, Freeman 1947).

Sterigma ($sternum_8$ or genital plate, latter used by Powell 1964) semicircular, slightly concealed by posterior margins of $sternum_7$, bears ostium bursae (representing aperture of ductus bursa). Posterior half of ductus bursae convoluted, slightly tapering into a single spiralled bulbous highly sclerotized structure; connects ostium bursa to bulla seminalis.

Bursa copulatrix large, saciform; possesses pair of invaginated signae. According to Matsuda (1976) signae

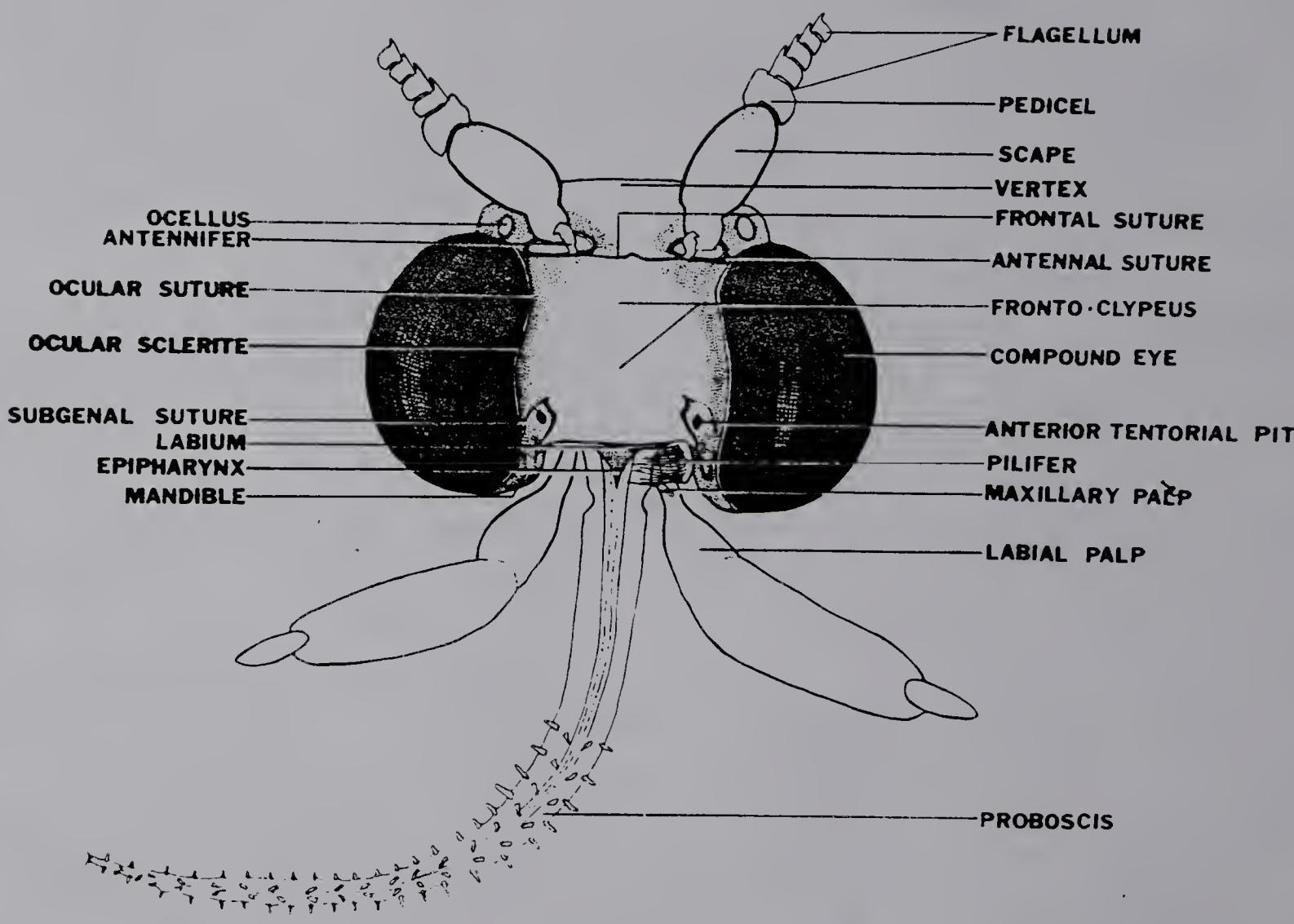
function to hold spermatophore of male in proper position.

Segment$_9$ greatly reduced. Tergite$_9$ represented by small pair of laterally situated apophyses. Function similar to anterior apophyses (Freeman 1947). Sternum$_9$ reduced to a pair of laterally situated sclerites; articulate with ventrolateral extensions of tergite$_8$.

Segment$_{10}$ represented by papillae anales; setose lobes flanking anus and ovipore. According to Kuznetsov (1919), the papillae are homologous with male uncus.

Plate 1. Fig. 1

Head (frontal view).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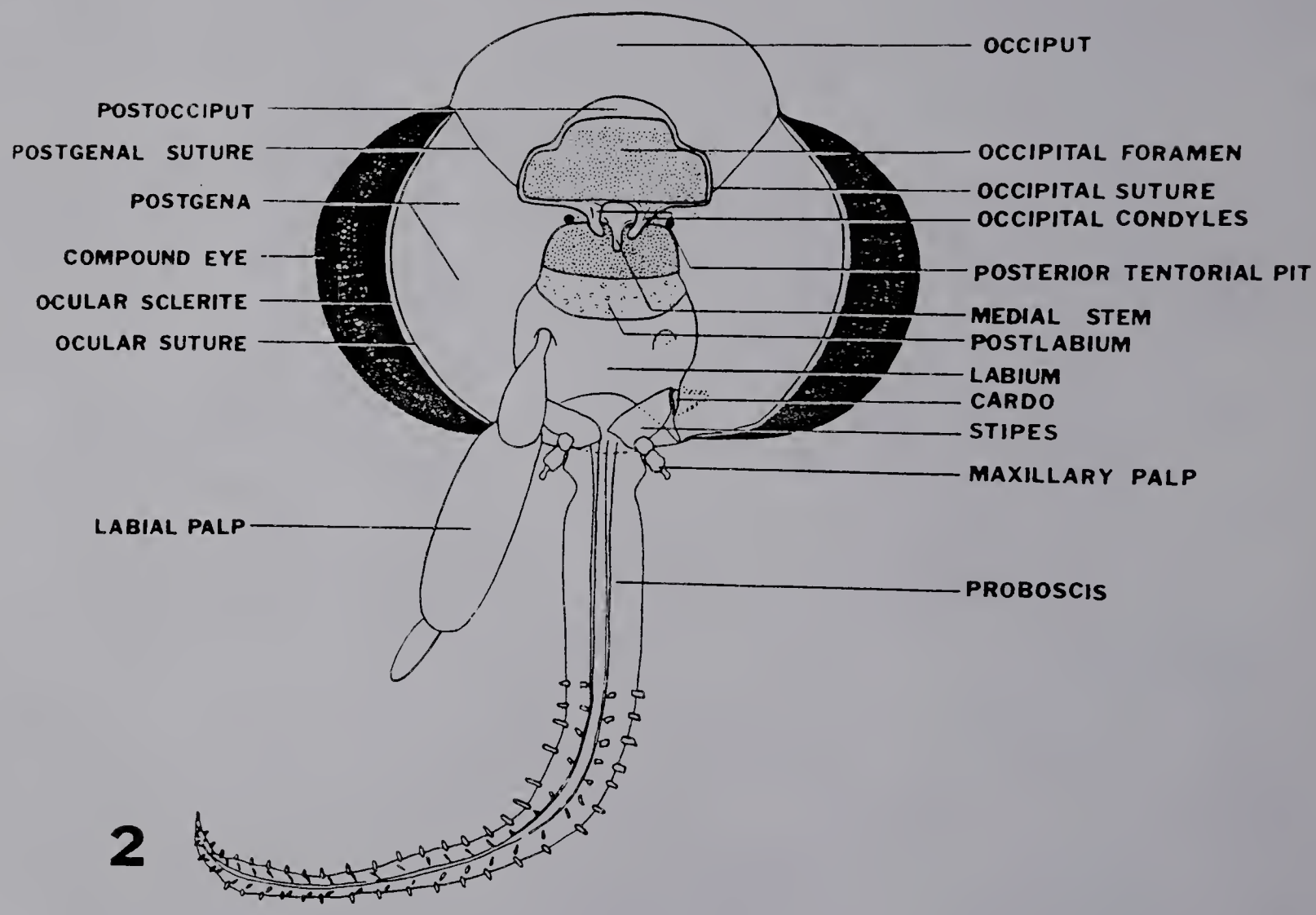
PEDICEL
SCAPE
VERTEX
FRONTAL SUTURE
ANTENNAL SUTURE
FRONTO·CLYPEUS
COMPOUND EYE
ANTERIOR TENTORIAL PIT
PILIFER
MAXILLARY PALP
LABIAL PALP
PROBOSCIS
OCELLUS
ANTENNIFER
OCULAR SUTURE
OCULAR SCLERITE
SUBGENAL SUTURE
LABIUM
EPIPHARYNX
MANDIBLE

1

Plate 1 Fig. 2

Head (posterior view).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POSTGENA
COMPOUND EYE
OCULAR SCLERITE
OCULAR SUTURE
OCCIPITAL FORAMEN
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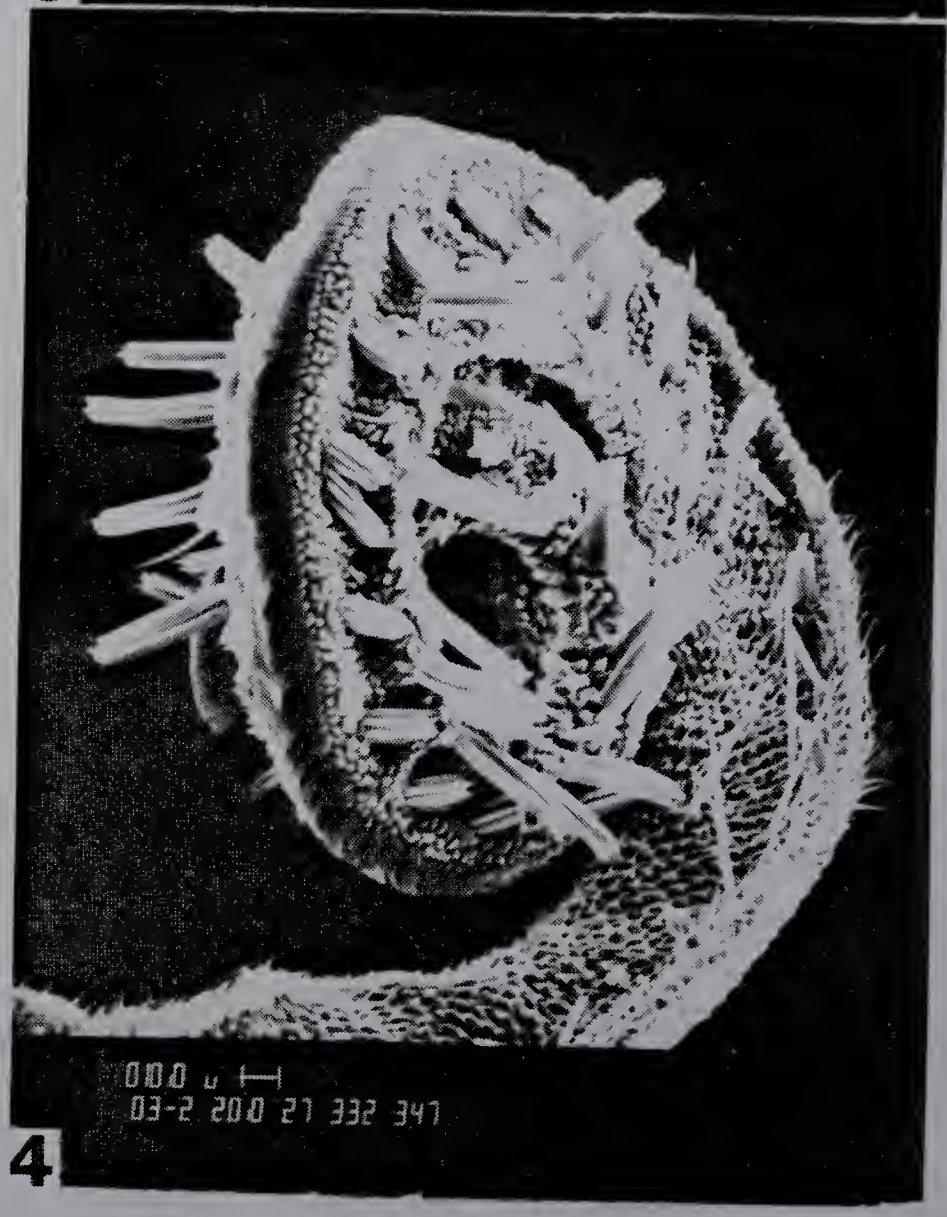
OCCIPITAL CONDYLES
POSTERIOR TENTORIAL PIT
MEDIAL STEM
POSTLABIUM
LABIUM
CARDO
STIPES
MAXILLARY PALP
LABIAL PALP
PROBOSCIS

2

Plate 2. Figs. 3-4

3, Head (lateral view). 4, Proboscis

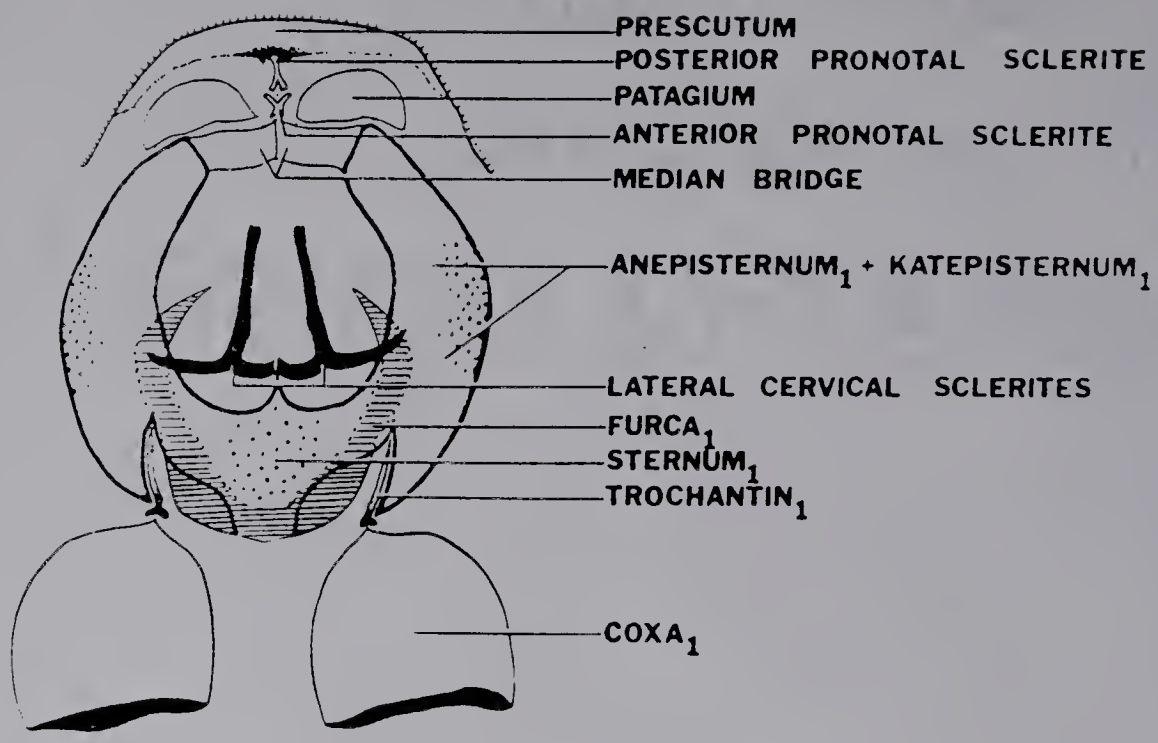
3



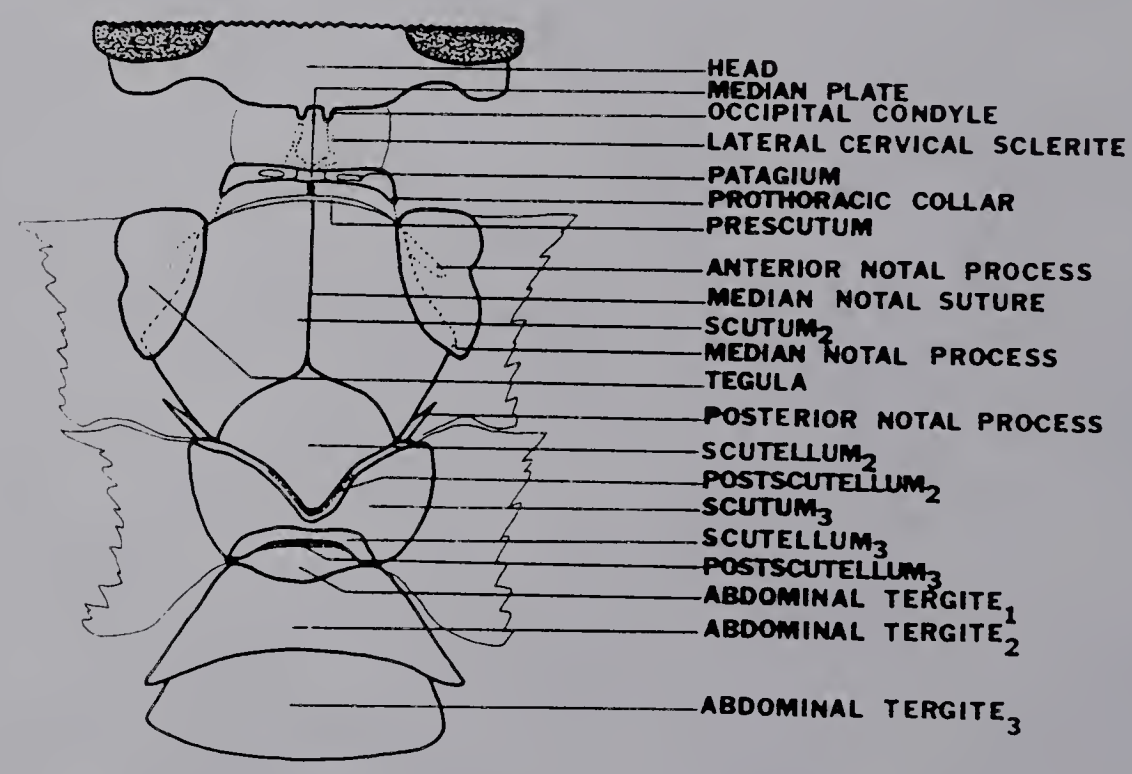
4

Plate 3. Figs. 5-7

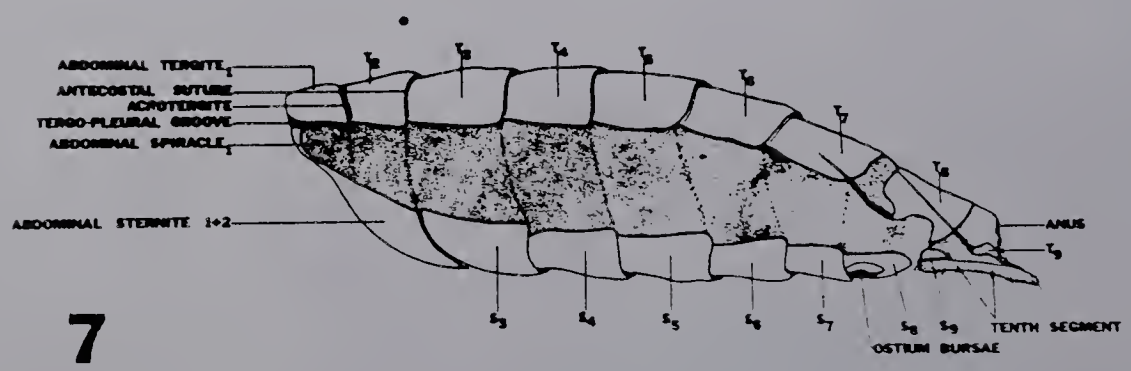
5, Pronotum (frontal view). 6, Thoracic region (dorsal view). 7, Female abdomen (lateral view).


PRESCUTUM
POSTERIOR PRONOTAL SCLERITE
PATAGIUM
ANTERIOR PRONOTAL SCLERITE
MEDIAN BRIDGE
ANEPISTERNUM1 + KATEPISTERNUM1
LATERAL CERVICAL SCLERITES
FURCA1
STERNUM1
TROCHANTIN1
COXA1

5


HEAD
MEDIAN PLATE
OCCIPITAL CONDYLE
LATERAL CERVICAL SCLERITE
PATAGIUM
PROTHORACIC COLLAR
PRESCUTUM
ANTERIOR NOTAL PROCESS
MEDIAN NOTAL SUTURE
SCUTUM2
MEDIAN NOTAL PROCESS
TEGULA
POSTERIOR NOTAL PROCESS
SCUTELLUM2
POSTSCUTELLUM2
SCUTUM3
SCUTELLUM3
POSTSCUTELLUM3
ABDOMINAL TERGITE1
ABDOMINAL TERGITE2
ABDOMINAL TERGITE3

6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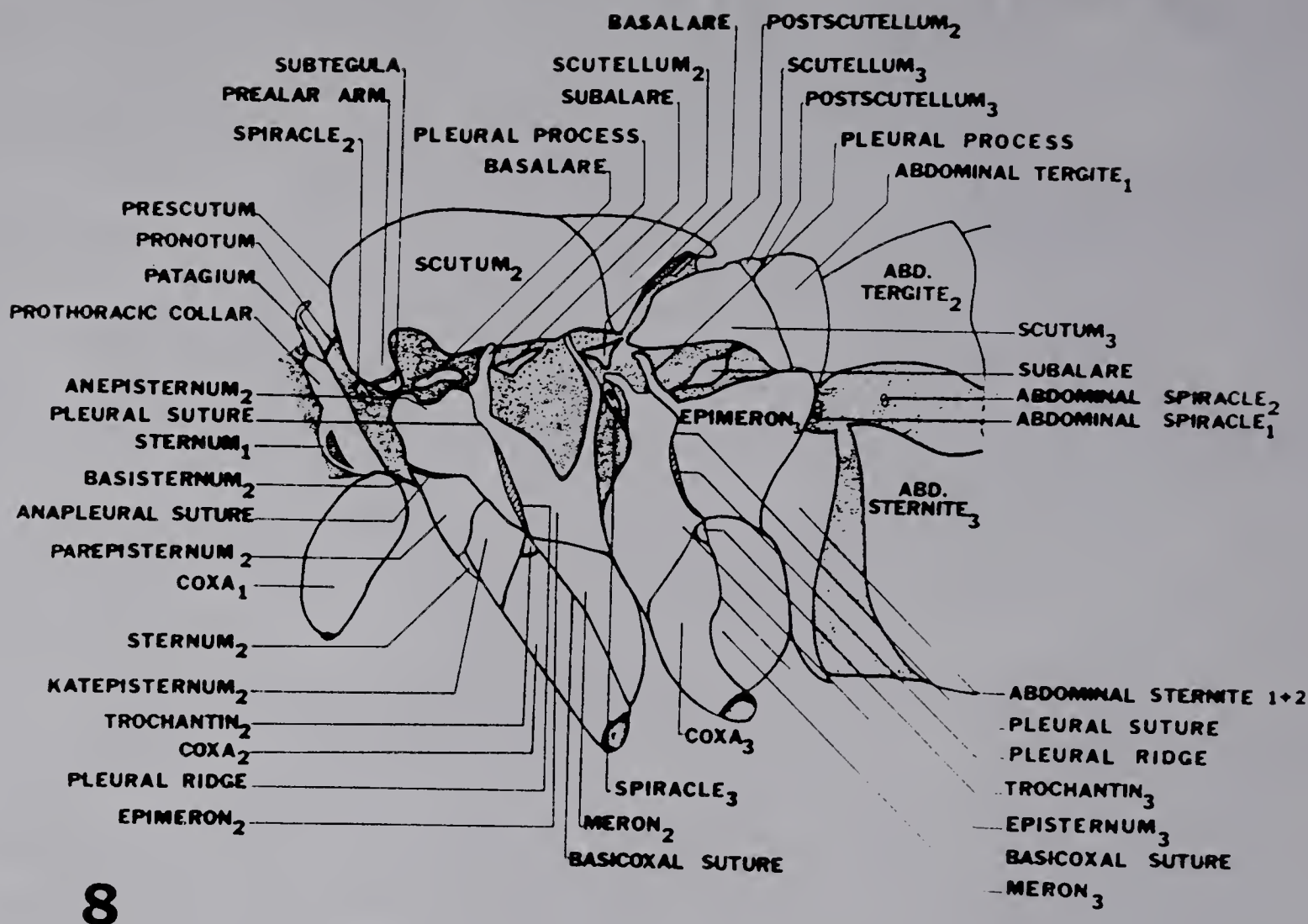
ANTECOSTAL SUTURE
ACROTERGITE
TERGO-PLEURAL GROOVE
ABDOMINAL SPIRACLE1
ABDOMINAL STERNITE 1+2
ANUS
TENTH SEGMENT
OSTIUM BURSAE

7

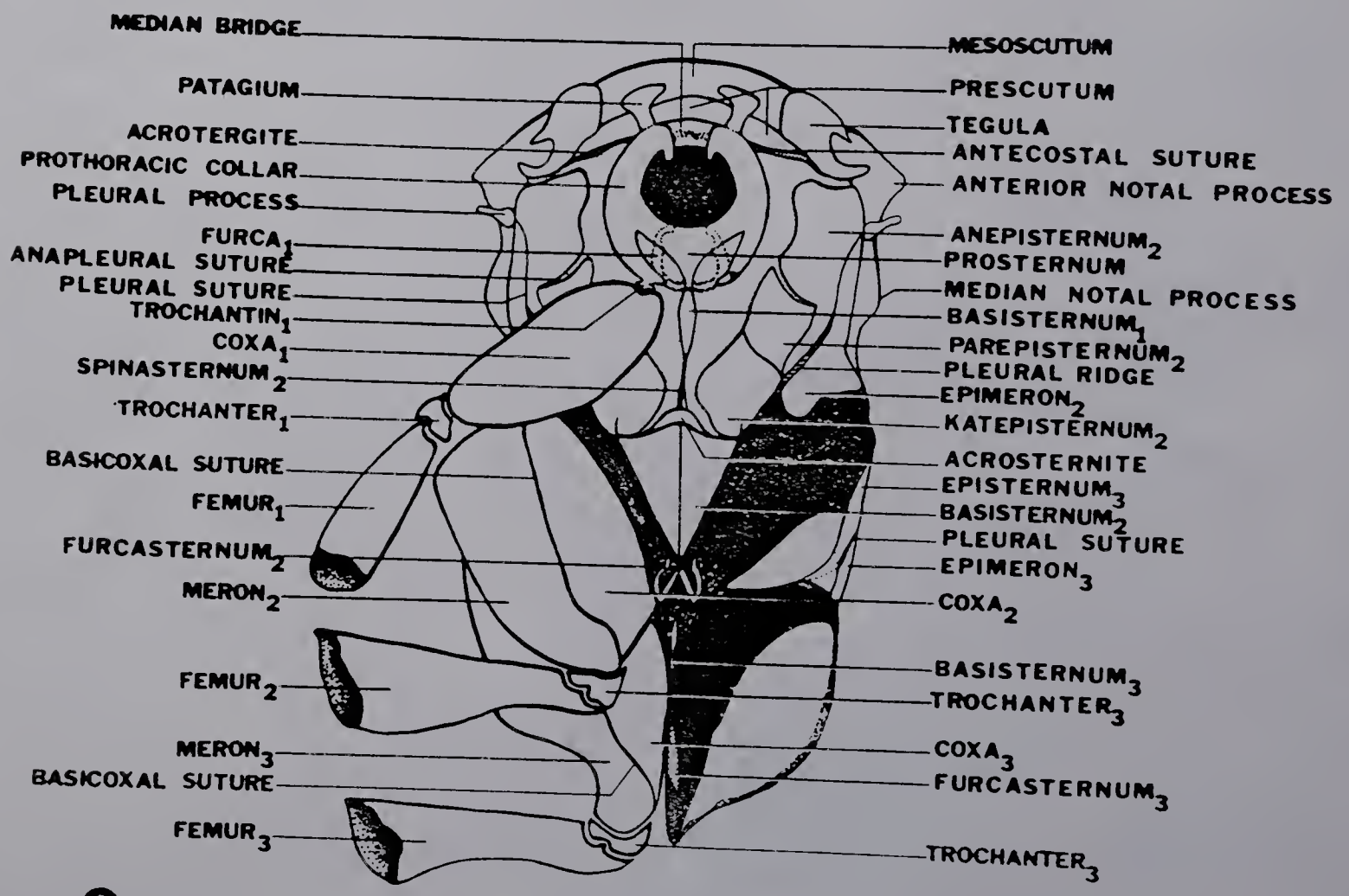
Plate 4. Figs. 8-9

8, Thoracic region (lateral view).

9, Thoracic region (ventral view).


BASALARE
POSTSCUTELLUM2
SUBTEGULA
SCUTELLUM2
SCUTELLUM3
PREALAR ARM
SUBALARE
POSTSCUTELLUM3
SPIRACLE2
PLEURAL PROCESS
PLEURAL PROCESS
BASALARE
ABDOMINAL TERGITE1
PRESCUTUM
PRONOTUM
PATAGIUM
PROTHORACIC COLLAR
SCUTUM2
ABD. TERGITE2
SCUTUM3
SUBALARE
ANEPISTERNUM2
PLEURAL SUTURE
STERNUM1
BASISTERNUM2
ANAPLEURAL SUTURE
PAREPISTERNUM2
COXA1
STERNUM2
KATEPISTERNUM2
TROCHANTIN2
COXA2
PLEURAL RIDGE
EPIMERON2
ABDOMINAL SPIRACLE2
ABDOMINAL SPIRACLE1
EPIMERON3
ABD. STERNITE3
COXA3
SPIRACLE3
MERON2
BASICOXAL SUTURE
ABDOMINAL STERNITE 1+2
PLEURAL SUTURE
PLEURAL RIDGE
TROCHANTIN3
EPISTERNUM3
BASICOXAL SUTURE
MERON3

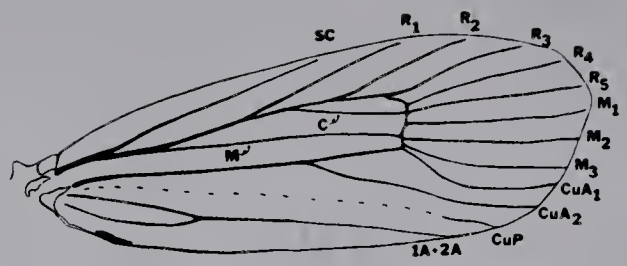
8


MEDIAN BRIDGE
MESOSCUTUM
PATAGIUM
PRESCUTUM
ACROTERGITE
TEGULA
PROTHORACIC COLLAR
ANTECOSTAL SUTURE
PLEURAL PROCESS
ANTERIOR NOTAL PROCESS
FURCA1
ANEPISTERNUM2
ANAPLEURAL SUTURE
PROSTERNUM
PLEURAL SUTURE
MEDIAN NOTAL PROCESS
TROCHANTIN1
BASISTERNUM1
COXA1
PAREPISTERNUM2
SPINASTERNUM2
PLEURAL RIDGE
TROCHANTER1
EPIMERON2
KATEPISTERNUM2
BASICOXAL SUTURE
ACROSTERNITE
FEMUR1
EPISTERNUM3
BASISTERNUM2
FURCASTERNUM2
PLEURAL SUTURE
MERON2
EPIMERON3
COXA2
FEMUR2
BASISTERNUM3
TROCHANTER3
MERON3
COXA3
BASICOXAL SUTURE
FURCASTERNUM3
FEMUR3
TROCHANTER3

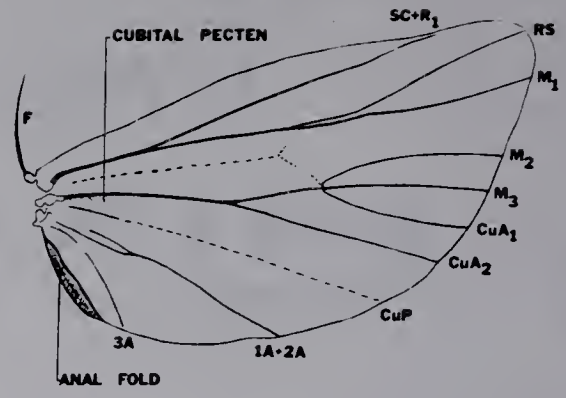
9

Plate 5. Figs. 10-13

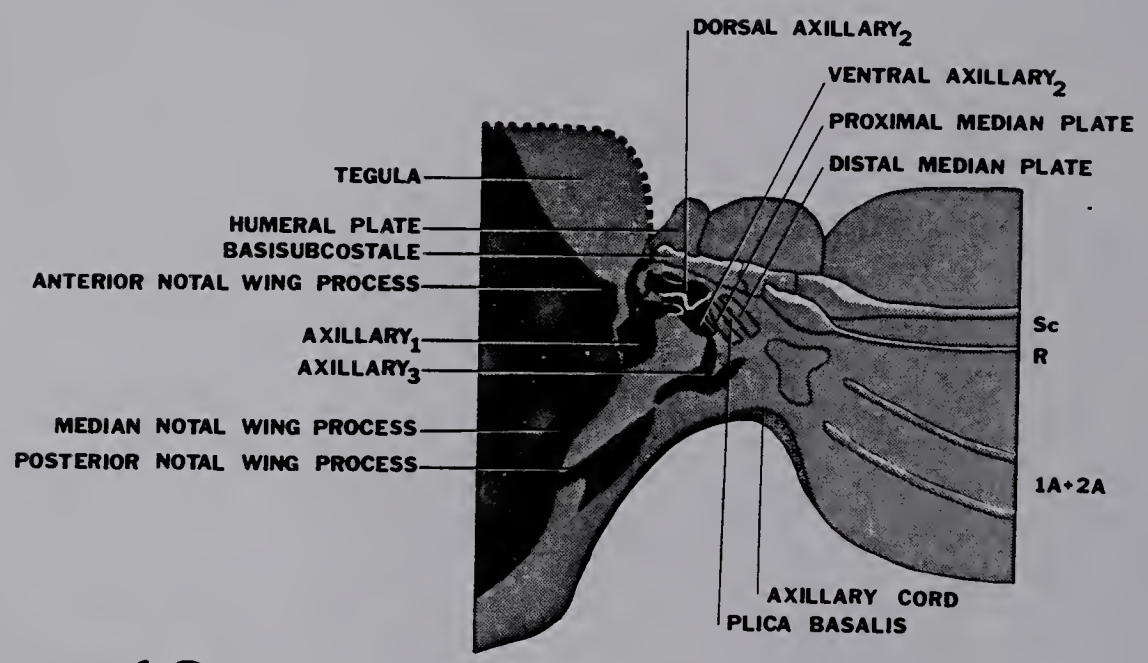
10, Male forewing. 11, Male hindwing.
12, Right forewing base of female (dorsal view).
13, Right hindwing base of male (dorsal view).


SC
R1
R2
R3
R4
R5
M1
M2
M3
CuA1
CuA2
CuP
1A+2A
C'
M'

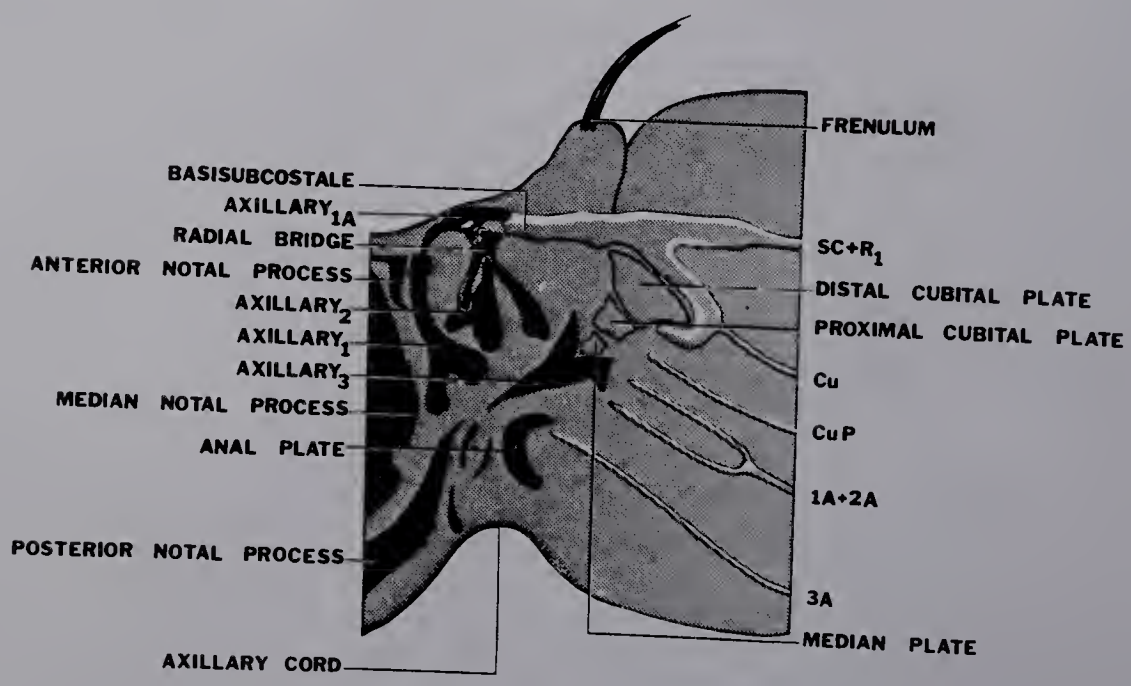
10


CUBITAL PECTEN
SC+R1
RS
M1
M2
M3
CuA1
CuA2
CuP
3A
1A+2A
ANAL FOLD
F

11


DORSAL AXILLARY2
VENTRAL AXILLARY2
PROXIMAL MEDIAN PLATE
DISTAL MEDIAN PLATE
TEGULA
HUMERAL PLATE
BASISUBCOSTALE
ANTERIOR NOTAL WING PROCESS
AXILLARY1
AXILLARY3
MEDIAN NOTAL WING PROCESS
POSTERIOR NOTAL WING PROCESS
Sc
R
1A+2A
AXILLARY CORD
PLICA BASALIS

12


FRENULUM
BASISUBCOSTALE
AXILLARY1A
RADIAL BRIDGE
ANTERIOR NOTAL PROCESS
AXILLARY2
AXILLARY1
AXILLARY3
MEDIAN NOTAL PROCESS
ANAL PLATE
POSTERIOR NOTAL PROCESS
AXILLARY CORD
SC+R1
DISTAL CUBITAL PLATE
PROXIMAL CUBITAL PLATE
Cu
CuP
1A+2A
3A
MEDIAN PLATE

13

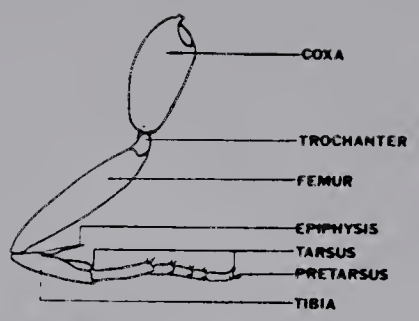
Plate 6. Figs. 14-19

14, Prothoracic leg. 15, Mesothoracic leg.

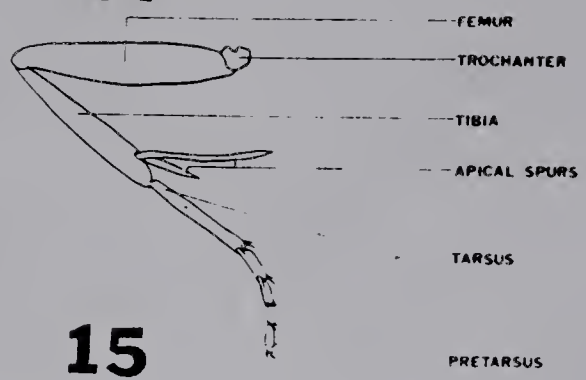
16, Metathoracic leg (female) and metathoracic leg (male).

17, Pretarsus (ventral view). 18, Male abdomen (lateral view)

19, Male genitalia (posteroventral view)



14



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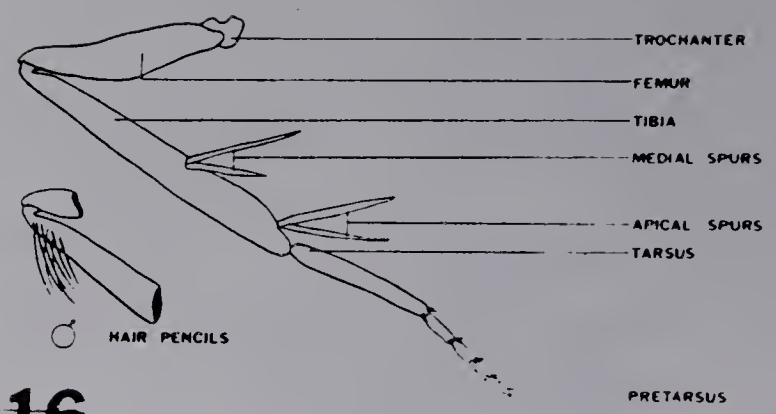
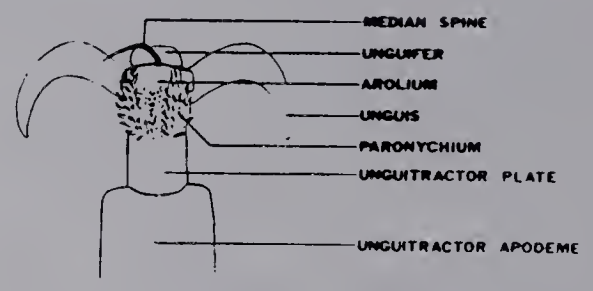
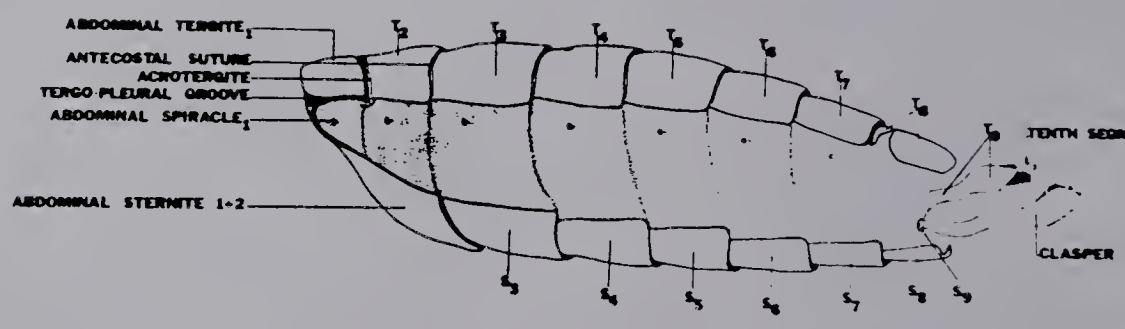


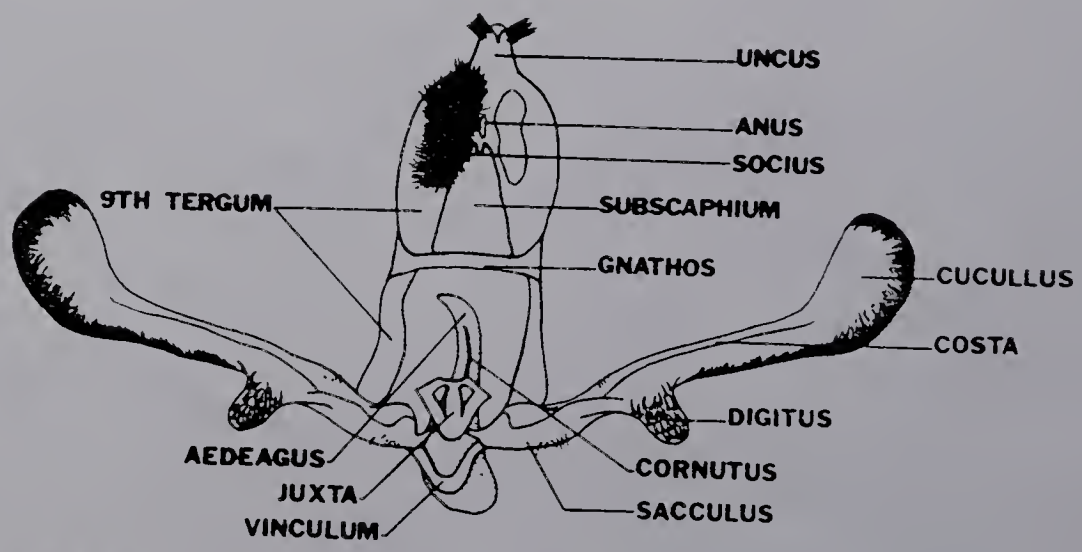
16



17



18



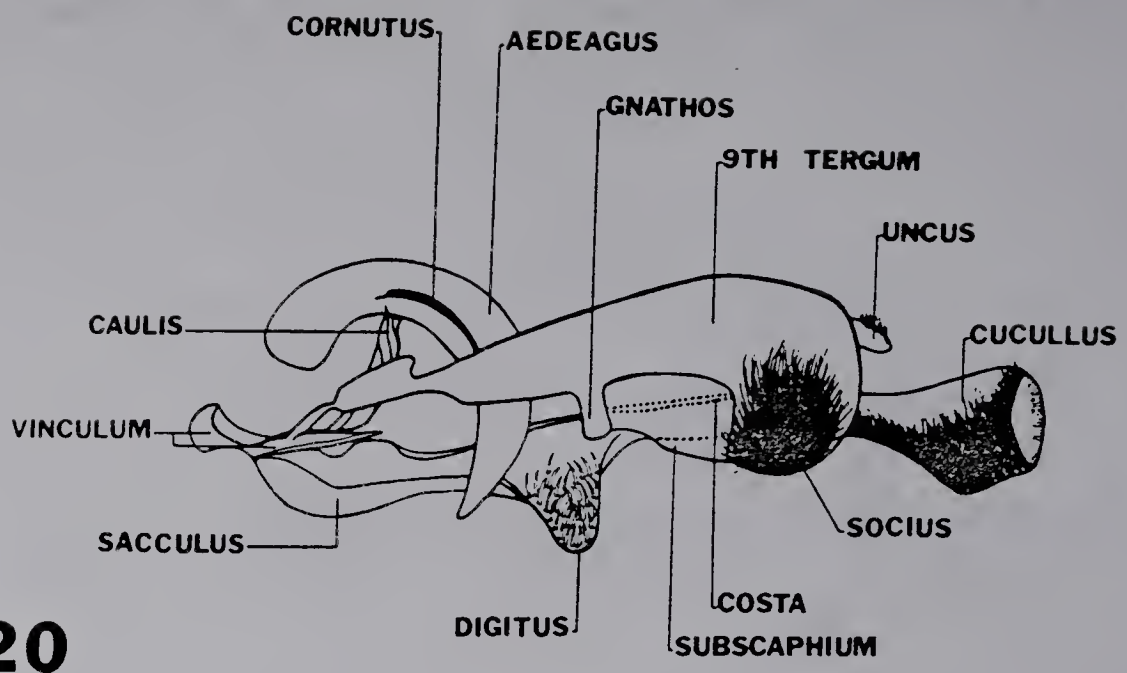
19

Plate 7. Figs. 20-22

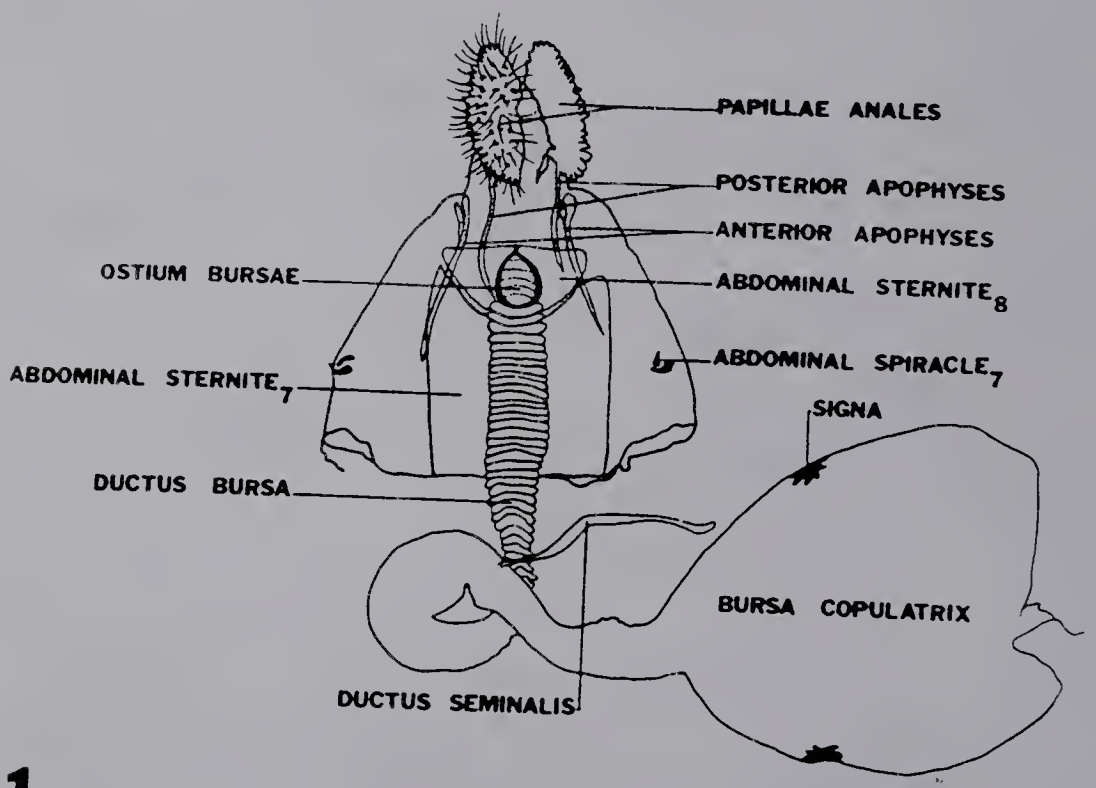
20, Male genitalia (lateral view).

21, Female genitalia (posteroventral view).

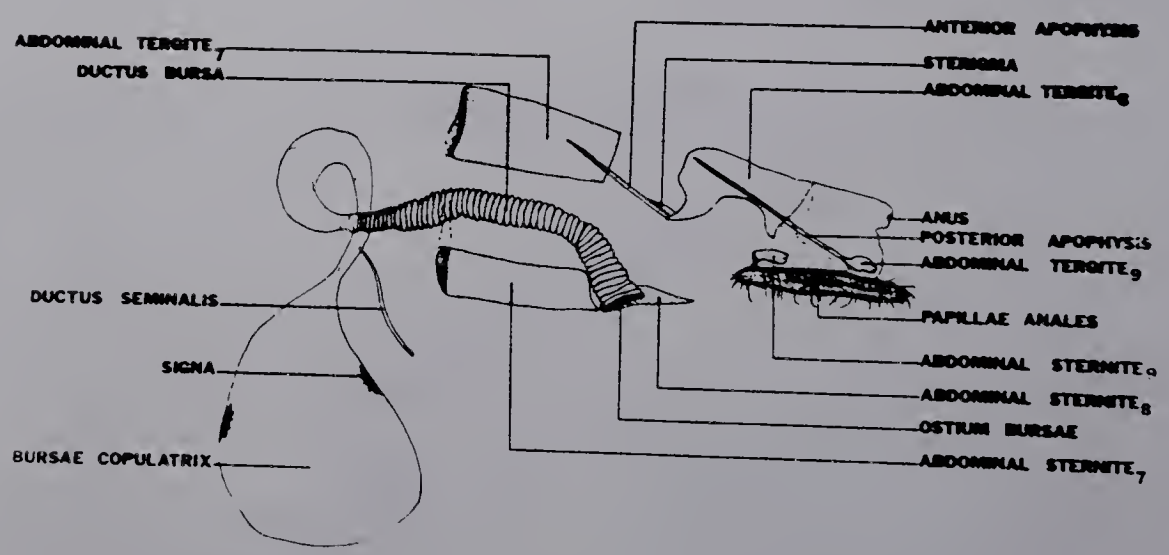
22, Female genitalia (lateral view).


CORNUTUS
AEDEAGUS
GNATHOS
9TH TERGUM
UNCUS
CAULIS
CUCULLUS
VINCULUM
SACCULUS
SOCIUS
COSTA
DIGITUS
SUBSCAPHIUM

20


PAPILLAE ANALES
POSTERIOR APOPHYSES
ANTERIOR APOPHYSES
OSTIUM BURSAE
ABDOMINAL STERNITE 8
ABDOMINAL SPIRACLE 7
ABDOMINAL STERNITE 7
SIGNA
DUCTUS BURSA
BURSA COPULATRIX
DUCTUS SEMINALIS

21


ABDOMINAL TERGITE 7
DUCTUS BURSA
ANTERIOR APOPHYSES
STERIGMA
ABDOMINAL TERGITE 8
ANUS
POSTERIOR APOPHYSES
ABDOMINAL TERGITE 9
DUCTUS SEMINALIS
PAPILLAE ANALES
SIGNA
ABDOMINAL STERNITE 9
ABDOMINAL STERNITE 8
OSTIUM BURSAE
BURSAE COPULATRIX
ABDOMINAL STERNITE 7

22

C H A P T E R I I I

REVISION OF NEARCTIC SPECIES OF THE MOTH GENUS APOTOMIS HUBNER (LEPIDOPTERA-TORTRICIDAE)

Introduction

Species within the genus Apotomis Hbn. are solitary feeders, living as leaf folders or tiers mostly on members of Betulaceae and Salicaceae. They are known to occur throughout the nearctic region except for southeastern United States. Only 1 larvae, A. capreana, has been described, (MacKay 1959). Many species are rarely collected. No nearctic species of Apotomis is known to be economically important.

In a forthcoming checklist (Powell, in press) the subfamilies, Tortricinae, Olethreutinae, and Chlidanotinae are recognized as constituting the North American Tortricidae. Within the Nearctic region the vast majority of the approximately 1,000 known species are placed in the Olethreutinae. Limited revisionary work has been undertaken since Heinrich (1923, 26). These include: Zeiraphera (Mutuura and Freeman 1966), part of Petrova (Miller 1979), Rhyacionia (Powell and Miller 1978), part of Apotomis (Miller 1979), part of Cydia (Brown 1979) and Epinotia (Brown 1980 and Ph.D. dissertation).

The studies cited above indicate that future revision at all levels of taxonomy is necessary.

The study presented here has dealt with several problems in determining the species identity of specimens within Apotomis. These include: small size, extensive wing pattern polymorphism, and lack of distinguishing wing pattern characteristics, all of which dictate the dissection and examination of male and female genitalia.

Materials and Methods

Specimens used in this study were borrowed from the collections listed below. Abbreviations used in the text indicate where type-material is deposited.

AEB - Collection of A.E. Brower, Augusta, Maine

AMNH - American Museum of Natural History, New York, New York

ANSP - Academy of Natural Sciences, Philadelphia, Pennsylvania

CAS - California Academy of Sciences, San Francisco, California

CPK - Collection of Charles P. Kimball, Barnstable, Massachusetts

CNC - Canadian National Collections, Ottawa, Ontario, Canada

CU - Cornell University, Ithaca, New York

EEM - Essig Entomology Museum, Berkeley, California

FMNH - Field Museum of Natural History, Chicago, Illinois

INHS - Illinois State Natural History Survey, Urbana, Illinois

LEM - Lyman Entomological Museum, McGill University, P.Q. Canada

NDSU - North Dakota State University, Fargo, North Dakota

NYED - New York State Education Department, Albany, New York

SEM - Spencer Entomological Museum, University of British Columbia, Vancouver, B.C. Canada

UA - University of Alberta, Edmonton, Alberta, Canada

USNM - United States National Museum, Washington, D.C.

UWM - University of Wisconsin-Madison, Madison Wisconsin

Two hundred and five genitalia slides were prepared, following Clarke (1941). They were examined with stereoscopic dissecting and interference-contrast microscopes. All slide data were recorded in an unpublished register. Male and female of each species are illustrated with the aid of a slide projector. Description of the adults was made from specimens examined under an incandescent light source (reflected light) while using The Methuen Handbook of Colour (Kornerup and Wanscher, 1978) as a standard for color definition. A generalized illustration of the wing pattern of Apotomis modified from Bradley, Tremenan & Smith (1973) is presented.

Genus Apotomis Hubner

Type-Species: Apotomis turbidana Hbn. [1825]. By subsequent designation (Fernald, 1908, Genera Tortricidae: 10, 56). Olethreutini.

Limma Hubner, [1825]. Verz. bekannter Schmett.:380.

Aphania Hubner, [1825]. Verz. bekannter Schmett.:386.

Antithesia Stephens, 1829, Syst. Cat. Brit. Ins. 2:172.

Brachytaenia Stephens, 1852, List Specimens Brit. Ani. Coll. Brit. Mus. 10:25.

Heinrich (1926) recognized both Antithesia and Brachytaenia as junior synonyms of Aphania. Bradley et al (1972)

recognized Apotomis as a senior synonym for Antithesia and Brachytaenia. Razowski (1976) and Powell (in press) subsequently added Limma to the list of synonymies. Both investigators recognized Apotomis by page preference. A. turbidana is the type-species for Apotomis Hbn. by subsequent designation of Fernald 1908.

Key to the Species of Apotomis Hbn.

1. Apical 1/3 of forewing distinctly lighter in color than basal 2/3 2

1'. Apical 1/3 of forewing similar or nearly similar in color to basal 2/3 10

2. Median inflection of apical wing blotch on forewing pointing posteriorly 3

2'. Median inflection of apical wing blotch on forewing blunt, not pointing posteriorly, or not present . 7

3. White suffuse streak present, originating at mid-line of the base of forewing between median and Cu branch of discal cell, never extending beyond proximal apex of median dash. Male cornutus single, medium sized, straight; Spc_1 *dense, spines stout and spatulate; ventral margin of sacculus round; cucullus weakly produced vertically. Female - valva ovate and posteriorly elongate; sterigma sagittate; bulbous area of ductus anterior to 7th sternite . . . . . paludicolana

3'. White suffuse band present between media and Cu branch of discal cell intersecting with apical wing blotch; dark gray streak on posterior margin of forewings always present. Male - cornutus single,

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*Spc_1 = Notation used by Heinrich (1926) to represent the major spine cluster on the sacculus.

medium sized, straight or curved; Spc_1 dense spines moderately long and spatulate; digitus "finger-like" (fig. 10). Outer margin slightly concave; cucullus produced vertically; ventral margin of sacculus round. Female - valva "tear-shaped"; sterigma semi-circular (fig. 14); ductus strongly reticulate; bulbous area anterior to 7th sternite . . . . . albeolana

3''. White suffuse streak not present on forewings . . . 4

4. Median inflection of apical wing blotch faint, separated or nearly so from postmedian fascia by brown scales. Male - cornutus single, long, slightly curved; Spc_1 dense towards apex, spines short and spatulate; cucullus weakly produced vertically; ventral margin of sacculus angular (fig. 11). Female - valva circular; sterigma (fig. 13) in 2 parts each subcircular bissected by valva; posterior portion of ductus sclerotized, lacking reticulation; bulbous area anterior to 7th sternite . . . . . apateticana

4'. Median inflection distinct, wide at base 5

5. Forewings linear; apical wing blotch white, light brown, or grayish brown; dark specimens may lack banding on pro- and mesothoracic legs. Male -

cornutus single, medium sized, straight; Spc_1 dense, spines stout and spatulate; cuculus (fig. 2) weakly produced vertically; ventral margin of sacculus round. Female - valva ovate; sterigma sagittate; ductus moderately reticulate, bulbous area partially anterior to 7th sternite . frigidana

5'. Wings not linear, wing blotch always white 6

6. Basal 2/3 of forewings light grayish brown; median dash distinct; alar expanse 7.90-9.03 mm. Male - cornutus single, short, and straight; Spc_1 dense towards apex (fig. 6, 7), spines stout and spatulate; cucullus strongly produced vertically; ventral margin of sacculus round. Female - valva "tear-shaped"; sterigma sagittate; ductus moderately reticulate; bulbous area anterior to 7th sternite . . capreana

6'. Basal 2/3 of forewings brown; media not distinct; alar expanse 7.33-8.17 mm. Male - cornutus single, long, straight, occasionally spiralled; Spc_1 dense, spines stout and spatulate; cucullus weakly produced vertically; ventral margin of sacculus moderately angular. Female - valva ovate; sterigma semicircular; posterior portion of ductus sclerotized, lacking reticulation; bulbous area partially anterior to 7th sternite . . . . . spinulana

7. Apical wing blotch white; apex and termen light brown to grayish brown; median inflection of apical wing blotch blunt 8

7'. Subapical area brown to dark brown reducing white apical wing blotch to postmedian fascia. Median inflection blunt or not present 9

8. Male - cornutus single, medium sized, straight or curved; Spc_1 dense, spines stout and spatulate; digitus subtriangular (fig. 8); cucullus strongly produced vertically; ventral margin of sacculus round. Female - valva "tear-shaped"; sterigma sagittate (fig. 15); ductus moderately reticulate; bulbous area partially anterior to 7th sternite . . . . . funerea

8'. Male - cornutus minute, bifid. and Spc_1 dense, spines short and spatulate; cucullus weakly produced vertically; ventral margin of sacculus round. Female - valva ovate; sterigma semicircular; ductus moderately reticulate; bulbous area partially anterior to 7th sternite . . . . . bifida

8''. Male - cornutus minute and single; Spc_1 dense, spines short and spatulate; cucullus weakly produced vertically. Female - unknown . . . brevicornutana

9. Male - cornutus minute single, straight or curved; Spc_1 moderately dense towards apex, spines stout and spatulate; cucullus weakly produced vertically. Female - valva ovate; sterigma semicircular; ductus moderately reticulate; bulbous area partially anterior to 7th sternite . . . . . .tertiana

9'. Male - cornutus long single, "sickle-shaped"; Spc_1 moderately dense (fig. 4), spines long, thin and spatulate; cucullus weakly produced vertically; ventral margin of sacculus round (fig. 12). Female - unknown . . . . . afficticia

10. Dorsal wing pattern "calico" or "smudged"; median dash absent occasionally specimens with dark grayish brown fasciae or streak parallel to posterior margin of forewing; Male - cornutus single, medium sized, straight; Spc_1 dense, spines stout and spatulate; cucullus strongly produced vertically; ventral margin of sacculus round. Female - valva "tear-shaped"; sterigma sagittate; ductus moderately reticulate; bulbous area anterior to 7th sternite . . . . . removana

10'. Dorsal wing pattern not as above, median dash present 11

11. Basal fascia irregularly shaped tapering posteriorly usually with a dark narrow brown streak. Median fascia dark grayish brown extending beyond median dash. Male - cornutus single, medium sized, straight; Spc_1 dense, spines stout and spatulate; digitus narrow, round at apex, cucullus strongly produced vertically; ventral margin of sacculus moderately angular. Female - valva ovate; sterigma semicircular; posterior portion of ductus sclerotized, lacking reticulation; bulbous area anterior to 7th sternite . . . . . deceptana

11'. Basal fascia without narrow dark brown streak. Male - cornutus single, long, slightly curved; Spc_1 dense, spines stout and spatulate; cucullus strongly produced vertically ventrad margin of sacculus round. Female - unknown . . . coloradensis

11''. Basal fascia without a narrow dark brown streak; median fascia usually terminating on median dash 12

12. Male - aedeagus with sclerotized ovate area toward apex, bearing 3-6 "peg-like" structures; cornutus single, (if not single see 12) medium sized, slightly curved; Spc_1 dense toward apex, spines long, thin, and spatulate (fig. 5); digitus broad at apex,

(fig. 9); cucullus strongly produced vertically, ventral margin slightly expanded; ventral margin of sacculus angular. Female - valva circular; sterigma in 2 parts, bissected by valva; posterior portion of ductus sclerotized, lacking reticulation; central area of ductus linear (not bulbous), anterior to 7th sternite . . . . . infida

12'. Cornutus not single 13

13. Male - cornutus trifid, medium sized; cucullus strongly produced vertically, ventral margin expanded; ventral margin of sacculus round (fig. 3). Female - unknown . . . . . trifida

13'. Male - Spc_1 dense, spines stout and spatulate; cucullus strongly produced vertically; ventral margin of sacculus moderately angular. Female - unknown . . . . . spurinfida

Apotomis albeolana (Zeller) new Combination

(figs. 10, 14, 30, 39)

Penthina albeolana Zeller, 1875, Verh. Zool - bot. Ges. Wien, 25:262-63.

Olethreutes hartmanniana albeolana Fernald, 1903, in Dyar, List of No. Amer. Lepid. no. 5035, p. 452.

Olethreutes albeolana Kearfott, 1905, Can Ent. 37:43; 1910, Ins. New Jersey, p. 540. - Forbes, 1923, mem. 68, Cornell Univ. Agr. Exp. Sta. p. 456.

Argyroploce albeolana Barnes and McDunnough, 1917, Check List Lepid. Bor. Amer., no. 6816, p. 168.

Aphania albeolana Heinrich, 1926, Rev. of No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pls. 45, 65, p. 119.

Diagnosis: May be distinguished from other Apotomis by: lighter forewing scale pattern (apical wing blotch not prominent). Male digitus elongate, outer margin slightly concave digitus in male genitalia; highly reticulated ductus in the female genitalia and semi-circular sterigma.

Head: Vertex grayish brown mixed with white; basal 1/2 of palps white, distal 1/2 dark gray. Male flagellum 45-49 flagellomeres (n=4), female 47-49 (N=4).

Thorax: Mesothorax and tegulae grayish brown mixed with white, both with a distinct dark gray median transverse

band. White beneath.

Forewings: Alar expanse: Male 7.16-8.33 mm (N=25); Female 7.26 - 8.76 mm (N=25). White apical wing blotch and median inflection present but not distinctive due to light scale pattern of the basal 2/3 of wing. Median and postbasal fasciae dark grayish brown; terminated posteriorly by a suffuse white band. Median dash present or absent. Basal 2/3 of posterior margin streaked with dark grayish brown. Nine pairs of narrow costal strigulae present: 2 faint white pairs on basal and postbasal fascia, 2 light gray pairs on median fascia, and 3 white pairs on apical 1/3 of wing. Postmedian fascia with 2 irregularly shaped transverse bars; the most distal bar is usually darker and shorter; occasionally containing 2-3 minute dark brown dots or lines. Outer fringe light grayish brown except at tornus which is white. Ventral surface white or light grayish brown; white costal strigulae present; dorsal pattern visible through scales.

Hindwings: White at base, darkening gradually toward apex and outer margin. Outer fringe light grayish brown. Ventral surface white with grayish brown maculations toward apex.

Legs: Pro- and mesothoracic legs dark gray with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Light grayish brown without contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight or curved; lower margin of sacculus round; outer margin of digitus slightly concave, apex round and narrow; spine cluster dense. Spines moderately long, slightly spatulate. Cucullus strongly produced vertically.

Female Genitalia: Ostium "tear-shaped"; sterigma semi-circular. Ductus highly reticulate posteriorly; central portion curled and bulbous, anterior to 7th sternite.

Hosts: Betula papyrifera (from pinned specimen); Betula spp. (Prentice 1965); Betula alba (Kearfott 1905).

Specimens Examined: Photographic copies prepared at British Museum (Natural History), London, of Holotype male of pinned specimen and associated genitalia. Slide No. 11614. In British Museum.

NEW BRUNSWICK: Chamcook, Shippigan, St. Andrews, Tabusintac. QUEBEC: Brysonville, Brakley Beach - Can. Nat'l. Park, Lac Marios, Montreal, Pincourt Ile., Ste. Anne de Bellevue, Rapides; NOVA SCOTIA: Annapolis, Bridgetown, Halifax Co., Queens Co., S.

Milford. CONNECTICUT: East River, Killington Rd., New Cannan, Putnam; MAINE: Bangor, Bar Harbor, Orono, Rockport, Sebec Lake; MASSACHUSETTS: Amherst, Barnstable, Cohasset, E. Wareham, Holliston, Martha's Vinehard, Paxton, Princeton, Weston; NEW HAMPSHIRE: Hampton; NEW JERSEY: Elizabeth, Essex Co., Park, Lukehurst, Newark, Oakland; NEW YORK: Broadalbin, Calverton, Dryden, Enfield, New Windsor, Orient, Penobscot Co., Riverhead; RHODE ISLAND: Elmwood; VERMONT: West Sandgate. - 287

Apotomis afficiticia (Heinrich) new Combination

(figs. 4, 12, 20)

Aphania afficticia Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pl. 63, p. 118.

Diagnosis: Can be separated from other Apotomis by forewing pattern, except for some specimens of tertiana. Comparison of male genitalia reveals that afficticia possesses an aedeagus which is wider at its base, cornutus approximately 2-1/2 times longer, and the spines on digitus moderately long.

Head: Vertex grayish brown, mixed with white; basal 1/3 of palps white, distal 2/3 grayish brown.

Thorax: Mesothorax and tegulae grayish brown mixed with

white, the former with a dark brown transverse median band. White beneath.

Forewings: Alar expanse; Male 7.35 mm (N=1). Basal 2/3 grayish brown mixed with dark brown. All fascia incomplete. Median fascia, dark brown; narrowed posteriorly terminating on median dash. Basal and postbasal fascia faint and incomplete. Nine pairs of faint white strigulae present; 2 pairs on basal, postbasal and median fascia, 3 white pairs on apical 1/3 of wing. Subapical area and termen dark brown, reducing apical wing blotch in size to only post-median fascia. Median inflection blunt. Postmedian fascia possessing 2 irregularly shaped transverse bars; distal bar is darker and shorter, containing 3 minute darker brown dashes. Outer fringe brown except at tornus which is white. Ventral surface light brown; white costal strigulation present, dorsal pattern visible through scales.

Hindwings: Light brown at base, gradually darkening to apex and outer margin. Outer fringe white. Ventral surface light brown with brown maculations at apex.

Legs: Pro- and mesothoracic legs brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus "sickle-shaped"; ventral margin of sacculus round; outer margin of digitus convex, apex round. Spine cluster moderately dense. Spines long, thin, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Female unknown.

Hosts: Betula spp., (Prentice 1965).

Specimens Examined: Holotype - unique male, NEW HAMPSHIRE: Mt. Washington, 18-VII-1922, slide no. 2, from Kearfott coll., Ac. 4667 (AMNH) - 1.

Apotomis apateticana (McDunnough)

(figs. 11, 13, 33, 43)

Argyroploce deceptana McDunnough, 1922, Can. Ent., 54: 44. (name preoccupied).

Argyroploce apeteticana McDunnough, 1922, Can. Ent., 54: 168. (a correction).

Olethreutes apateticana Forbes, 1923, mem. 68, Cornell Univ. Agr. Exp. Sta. p. 455.

Aphania apateticana Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pl. 45 and 64, p. 120.

Diagnosis: May be distinguished from other Apotomis by forewing pattern.

Head: Vertex with light brown scales anteriorly, white scales posteriorly; basal 1/3 of palps white, distal

2/3 light brown. Male flagellum 42-43 flagellomeres (N=2).

Thorax: Anterior 1/2 of tegulae dark brown, posterior 1/2 white. Most scales of mesothorax dark brown tipped with white. White beneath.

Forewings: Alar expanse: Male 6.33-7.83 mm (N=10), female 6.96 mm (N=1). Basal 2/3 of wing mottled light brown, and brown mixed with white. All fasciae incomplete. Postbasal fascia light brown laterally flanked by darker basal and median fasciae. Median fascia narrowed posteriorly, continuing beyond median dash but not meeting posterior margin. Median dash dark brown, bissected by median inflection of postmedian fascia. Median narrow at base, occasionally separated from apical wing blotch by brown scales. Postmedian fascia with 2 irregularly shaped transverse bars; distal bar is usually darker and shorter, occasionally containing 0-2 minute brown dots or dashes. Costal strigulation on basal and postbasal fascia indiscernible; 2 pairs light brown on median fascia and 3 pairs white on apical 1/3 of wing. Subapical area white outlined with brown at apex and termen. Fringe brown except at tornus which is white. Ventral surface light brown; white costal strigulae present; dorsal pattern visible

through scales.

Hindwings: White except at apex and outer margin. Outer fringe white. Ventral surface white; light brown at apex.

Legs: Pro- and mesothoracic legs brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus slightly curved; ventral margin of sacculus angular; outer margin of digitus convex, apex round and slightly narrow. Spine cluster dense toward apex. Spines moderately long, thin, spatulate. Cucullus weakly produced ventrally.

Female Genitalia: Ostium circular; sterigma in 2 parts, subcircular, each laterad to valva. Posterior part of ductus sclerotized; central part curled and bulbous, anterior to 7th sternite.

Hosts: Salix, (taken from pinned specimen), Betula, (Ferguson 1975).

Specimens examined: Holotype - male, ONTARIO: Ottawa, 5-VI-1906, slide no. 285, C.H. Young Collector (CNC). Paratype - female, ONTARIO, Ottawa, 24-VI-1905, No. slide no., series 285 (CNC). ALBERTA: Edmonton; ALASKA: "mile 20", Alaskan highway. - 8.

Apotomis bifida (McDunnough) new Combination

(figs. 26, 35)

Aphania bifida McDunnough, 1938, Can. Ent. 70:93-96.

Diagnosis: Can only be separated from funerea and brevicornutana by examination of genitalia slides. See remarks.

Head: Vertex brown mixed with white; palps basal 1/3 white, distal 2/3 brown.

Thorax: Mesothorax and tegulae brown mixed with white. The former mesothorax with dark brown transverse median band. White beneath.

Forewings: Alar expanse: Male 8.15 mm (N=1). Basal 2/3 of wing brown mixed with dark brown. All fasciae incomplete. Postbasal fascia slightly lighter in color than basal and median fasciae. Median fascia narrowed posteriorly abruptly terminating on median dash. Nine pairs of costal strigulae present: 2 faint pairs on basal, postbasal, median fascia, and 3 white pairs on distal 1/3 of wing. Apex and termen brown mixed with gray. Median inflection blunt (similar to A. funerea and A. brevicornutana), intersecting with ental apex of median dash. Postmedian fascia possessing 2 irregularly shaped transverse bars; the most distal bar is darker and shorter, containing 1 minute dark brown dash. Outer fringe brown

except at tornus which is white. Ventral surface brown; white costal strigulae present. Dorsal pattern slightly visible through scales.

Hindwings: Light brown at base, gradually darkening to apex and outer margin. Outer fringe white. Ventral surface light brown with brown maculation at apex.

Legs: Pro- and mesothoracic legs brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus bifid, slightly divergent; ventral margin of sacculus round; outer margin of digitus convex, apex round. Spine cluster dense. Spines stout and spatulate. Cucullus weakly produced vertically.

Female Genitalia: Ostium ovate; sterigma semicircular. Posterior portion of ductus moderately reticulate; central portion curled and bulbous, part extends anterior to 7th sternite.

Hosts: Alnus crispa var. mollis, USDA (Ferguson 1975).

Remarks: This species has been misidentified in many collections as funerea. There is question of the true identity of McDunnough's female paratype. He states, "the two specimens (holotype and allotype) are so identical in maculation that I have no

hesitation in associating them, despite the difference in locality." However, it is very possible that the specimen in question is that of brevicornutana, or perhaps of unknown specific identity. The diagnostic illustration of McDunnough's female bifida is presented, however, extensive collecting is needed to validate his claim.

Specimens Examined: Holotype - male, ONTARIO: Ottawa, Mer Bleue APH-11, 22-VII-1936, (W.J. Brown); No. 1421 (CNC). Paratype female, NOVA SCOTIA: White point beach, APH-11, 16-VIII-1936, (J. McDunnough), (CNC). - 2.

Apotomis brevicornutana (McDunnough) new Combination

(fig. 22)

Aphania brevicornuta McDunnough, 1938, Can. Ent. 70: 94

Mispelling. Synonmy.

Aphania brevicornutana McDunnough, 1938, Can. Ent. 70: 95-96.

Diagnosis: Can only be separated from funerea and bifida by examination of male genitalia slides.

Head: Vertex brown mixed with white; basal 1/3 of palps white, distal 2/3 brown.

Thorax: Mesothorax and tegulae brown mixed with white; mesothorax with dark transverse median band. White

beneath.

Forewings: Alar expanse: Male 7.15 mm (N=1). Basal 2/3 of wing brown mixed with dark brown. All fasciae incomplete. Postbasal fascia slightly lighter in color than basal and median fasciae. Median fascia narrowed posteriorly, abruptly terminating on median dash. Nine pairs of costal strigulae present; two faint pairs on basal, postbasal, median fascia, and 3 pairs on distal 1/2 of wing. Apex and termen brown mixed with gray. Median inflection blunt (similar to funerea and bifida), intersecting with ental apex of median dash. Postmedian fascia white, possessing only 1 light gray transverse band proximal to tornus and several sub-apical dots. Outer fringe brown except at tornus which is white. Ventral surface brown; white costal strigulae present; dorsal pattern slightly visible through scales.

Hindwings: Light brown at base gradually darkening to apex and outer margin. Outer margin white. Ventral surface light brown with brown maculations at apex.

Legs: Pro- and mesothoracic legs brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus straight with small subrectangular structure at base; ventral margin of sacculus round;

outer margin of digitus convex, apex round. Spine cluster dense. Spines stout, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Female unknown.

Hosts: Unknown.

Remarks: In compliance with Article 32(b) of the International Code of Zoological Nomenclature (Stoll et al 1964), brevicurnutana must be preferred over brevicurnuta. The former possessing the most appropriate latinized ending (brevicornuta = small horned), (brevicurnutana = small, horn-like).

Specimens Examined: Holotype - unique. Male, QUEBEC: Labr., Bonne Esperance, 14-VII-1929, (W.J. Brown), APH-6, No. 43338 (CNC) - 1.

Apotomis capreana (Hubner) new Combination
(figs. 6, 7, 24, 41)

Tortrix capreana Hubner [1825], Samm. Eur. Schmet. Tort., figs. 250, p. 40.

Penthina capreana Herrich-Schaffer, 1849, System. Schmett. Europa. (Microlep.) 6:227.

Antithesia capreana Wilkinson, 1859, Brit. Tort., p. 23-24.

Olethreutes capreana Staudinger and Rebel, 1901, cat. Lepid., no. 1864, 2:102 - Fernald, 1903, in Dyar List of No. Amer. Lepid., no. 5033, p. 451. - Kearfott, 1905, Can. Ent. 37:205; - Forbes, 1923, mem 68, Cornell Univ. Agr. Exp. Sta., p. 455.

Argyroploce capreana Kennell, 1913, Palaeark. Tort., Lfg. 3, Zoologica, 21:371, Heft 54. - Barnes and McDunnough, 1917, Check List of Lepid. of Bor. Amer., no. 6818, p. 168; - McDunnough, 1922, Can. Ent., 54-41.

Argyroploce funerea Meyrick, 1920, Exotic Microlep., 2:350 pt. 11.

Apotomis capreana Pierce and Metcalfe, 1922, Gen. of Brit. Tort., pl. 15, p. 42.

Apotomis capreana H. Krogerus, 1946, Die finnischen Apotomis Arten. (Lep. Tortricidae).

Apotomis capreana Bentinck and Diakonoff, 1968, de Nederlandse Bladrollers, pls. 24 and 89, p. 163; Bradley, Tremewan and Smith, 1979, Brit. Tort. Moths. 2:51-52.

Diagnosis: May be distinguished from funerea by median inflection which points posteriorly, smaller cornutus, shape of digitus, and size of spine cluster on digitus. Female capreana with smaller sterigma; bulbous area of ductus completely anterior to sternite. Small specimens of capreana may be confused with frigidana, however, forewing of the latter tends to be narrower.

Head: Vertex light grayish brown mixed with white; basal 1/2 of palps white, distal 1/2 brown. Male flagellum 44-50 flagellomeres (N-17), female 43-51 (N=8).

Thorax: Mesothorax and tegulae grayish brown, both with distinct dark brown transverse median band; bordered

anteriorly and posteriorly by 2 narrow, light brown bands. White beneath.

Forewings: Alar Expanse: male 8.00-9.03 mm (N=27), female 7.90-8.85 mm (N=15). Basal 2/3 of forewing light grayish brown mixed with dark brown. Median fascia brown, incomplete; narrowed posteriorly terminating on median dash. Basal and postbasal fasciae faint and incomplete. The median inflection of postmedian fascia is most distinctive; "comma-shaped", pointing posteriorly. Nine pairs of narrow costal strigulae present: 2 faint light brown pairs on the basal, postbasal, median fascia, and 3 white pairs on apical 1/3 of wing. Postmedian fascia with 2 irregularly shaped transverse bars; the most distal bar usually darker and shorter; occasionally containing 2-3 minute dark brown dots or lines. Apex and termen usually brown mixed with white. Outer fringe light brown except at tornus where it is white. Ventral surface brown; white costal strigulae present; distal 1/3 of median veins streaked with white; dorsal pattern visible through scales.

Hindwings: Light brown at base, darkening gradually toward apex and outer margin. Outer fringe white. Ventral surface light brown with brown maculations along anterior margin and apex.

Legs: Pro- and mesothoracic legs dark brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Light brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight; lower margin of sacculus round; base of digitus as wide as apex; outer margin slightly convex, apex round; spine cluster dense at apex. Spines stout, spatulate. Cucullus strongly produced dorsally.

Female Genitalia: Valva "tear-shaped"; sterigma sagittate. Ductus moderately reticulate posteriorly; central portion curled and bulbous, anterior to 7th sternite.

Hosts: Salix capreana (from pinned specimen); Populus, Betula, Salix discolor (Bradley 1973), Ulmus (Prentice 1965).

Remarks: Holarctic distribution. Comparison of Nearctic and Palearctic specimens has been made at British Museum (Natural History) London by Dr. J. D. Bradley. Holotype unknown.

Specimens Examined: Europe. ALBERTA: Banff, Edmonton, Elkwater, Lloydminster, Red Deer; BRITISH COLUMBIA: Clinton, Fraser Mills, Kasko, Squamish, Steelhead, Victoria; MANITOBA: Aweme;

NOVA SCOTIA: Baddeck, Digby Co., Brooklyn, Garland, Victoria Co.; ONTARIO: Blackburn, Geraldton, Normandale, Ottawa; QUEBEC: Pincourt Ile., Ste. Flore, Shawbridge; SASKATCHEWAN: Saskatoon; ARIZONA: Apache Co., CALIFORNIA: Humboldt Co.; CONNECTICUT: Granby; MAINE: Lincoln, Rangeley, Southwest Harbor, Woodland; MINNESOTA: Duluth, NEW HAMPSHIRE: Randolph; NEW YORK: Ithaca, Rochester; NORTH DAKOTA: Cass Co.; OREGON: Bandon, Couse Co.; WASHINGTON: Bellington, Hot Spring, Mt. Rainier; WISCONSIN: Oneida Co., Sayner; WYOMING: Carbon Co., Park Co. 290.

Apotomis coloradensis, Adamski, new species

(figs. 17, 47)

Diagnosis: Can be distinguished from most Apotomis by forewing pattern, except for specimens of infida, spurinfida, and coloradensis. In the latter cases comparison of male genitalia slides is necessary.

Head: Most scales on vertex grayish brown tipped with white; basal 1/3 of palps white, distal 2/3 grayish borwn.

Thorax: Mesothorax and tegulae with majority of scales grayish tipped with white. Mesothorax with dark grayish brown transverse median band. White beneath.

Forewings: Alar expanse: Male 9.00 mm (N=1). Holotype

slightly rubbed; wing pattern very similar to infida, spurinfida, trifida, and some specimens of deceptana. No white apical wing blotch. Median inflection not distinct. Postbasal fascia flanked by darker basal and median fasciae. Basal and median fasciae incomplete, latter narrowed posteriorly, abruptly terminating on median dash. Seven pairs of faint strigulae present: 2 pair on basal and median fascia, and 3 pair on apical 1/3 of wing. Basal strigulae absent. Apical area light brown. Postmedian fascia possessing 2 irregularly shaped transverse grayish brown bars. Outer fringe light brown. Ventral surface brown; light brown costal strigulation present, all veins streaked with white distally.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. Fringe white. Ventral surface white with brown maculations on anterior margin and apex.

Legs: Pro- and mesothoracic legs grayish-brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus slightly curved; ventral margin of sacculus round; outer margin of digitus slightly convex, apex round. Spine cluster dense. Spines stout, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Female unknown.

Hosts: Unknown

Specimens Examined: Holotype - unique male, COLORADO: Maysville, 17-VIII-1945. H. Ramstadt collector (918). D. Adamski Genitalia slide No. 565 (USNM no. 80, 084). - 1.

Apotomis deceptana (Kearfott) new Combination

(figs. 1, 19, 38)

Olethreutes deceptana Kearfott, 1905, 37:41-43, 207.

Argyroploce deceptana Barnes and McDunnough, 1917, Check List of Lepid. Bor. Amer., (No. 6819, p. 168. - Forbes, 1923, mem 68, Cornell Univ. Agr. Exp. Sta. p. 453.

Aphania deceptana Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132. pl. 44 and 62, p. 120.

Aphania salicaceana Freeman, 1957, Lepid. News. 11:27-28.

Aphania deceptana Miller, 1979, Great Lakes Ent. 12: 115-118.

Diagnosis: May be distinguished from other Apotomis by forewing pattern.

Head: Most scales of vertex grayish brown tipped with white; basal 1/2 of palps white, distal 1/2 grayish brown.

Thorax: Mesothorax and tegulae with most scales grayish

brown tipped with white. Mesothorax with dark brown transverse median band. White beneath.

Forewings: Alar expanse: Male 7.50-9.33 mm (N=7), female 10.0 mm (N=1). All fasciae present. No white apical wing blotch. Median inflection not evident. Postbasal fascia flanked by darker basal and median fasciae. Median fascia narrows posteriorly (like trifida) continuing beyond median dash, terminating in a light brown or dark brown irregular marking. Nine pairs of faint light brown strigulae present: 2 pairs on basal, postbasal, median fascia, and 3 pairs on apical 1/3 of wing. Often with basal strigulae. Basal fascia brown, incomplete, irregularly shaped, tapering posteriorly; with narrow dark brown streak. Distal 1/3 of wing light grayish brown. Postmedian fascia with 2 irregularly shaped transverse bars, the most distal usually darker. Outer fringe light brown. Ventral surface brown; white costal strigulae present, all veins on distal 1/3 of wing streaked with white.

Hindwings: White at base, gradually darkening toward apex and outer margin. Some specimens with light brown transverse maculations at apex. Outer fringe white. Ventral surface uniform white or white with

transverse light brown maculation on anterior margin and apex.

Legs: Pro- and mesothoracic legs grayish brown, banded with white on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus straight, ventral margin of sacculus moderately angular; outer margin of digitus strongly convex at base with slight concavity toward apex. Apex round. Spine cluster dense. Spines stout, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Ostium ovate; sterigma semicircular. Posterior part of ductus sclerotized, reticulation absent; central area curled and bulbous, extends anterior to 7th sternite.

Hosts: Salix and Populus, (Freeman 1957).

Specimens Examined: Lectotype, MANITOBA: Aweme, Criddle, 8-VIII-1904; 9-II-1078. (AMNH). A. Salicaceana, Holotype - Male ALBERTA: Red Deer, 24-VII-1923, slide no. 1. (CNC) A. salicaceana, paratype - Female, ONTARIO: Ottawa, 5-VIII-1905. (CNC). ALBERTA: Edmonton, Nordegg, Red Deer; MANITOBA: Winnepeg; ONTARIO: Biscotasing. MAINE: Estcourt Sta.,; MINNESOTA: Moorhead; WISCONSIN: Lake Katherine. -11.

Apotomis frigidana (Packard) new Combination

(figs. 2, 23, 45)

Penthina frigidana Packard, 1867, Proc. Boston Soc. Nat. Hist., 11:57

Olethreutes frigidana Fernald, 1903, in Dyar, List of No. Amer. Lepid., no. 5030; - Forbes 1923, mem 68 Cornell Univ. Agr. Exp. Sta., p. 454-455.

Penthina moeschleri Kennel, 1900, 13:249.

Olethreutes moeschleri Staudinger and Rebel, 1901, Cat. Lepid., no. 1870, 2:104.

Argyroploce moeschleri Kennel, 1913, Palaeark. Tort., Lfg. 3, Zoologica, 21: 377 Heft 54.

Argyroploce frigidana Barnes and McDunnough, Check List Lepid. Bur. Amer. No. 6817, p. 168.

Aphania frigidana Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pls. 44, 63, p. 116-17.

Diagnosis: Can be distinguished from all Apotomis by forewing pattern, except for small specimens of capreana. In this case, wing shape and examination of male and female genitalia slides will be necessary.

Head: Vertex uniform grayish brown or mixed with white; basal 1/3 of palps white, distal 2/3 grayish brown. Male flagellum 43 flagellomeres (N=2), Female 39-46 (N=50).

Thorax: Tegulae grayish brown mixed with white. All specimens examined exhibited incomplete or fully denuded upper thoracic regions precluding further description. Uniform, dark grayish brown or brown beneath.

Forewings: Alar expanse: Male 6.03-7.23 mm (N=10), Female 6.39-7.83 mm (N=10); generally more narrow than other Apotomis. Basal 2/3 of wing uniform dark brown, grayish brown, or mottled grayish brown mixed with dark brown and white. All fasciae may be present, incomplete or absent altogether. Median fascia usually absent, however, when present it is darkest area of wing; never extending to posterior margin. Median inflection of Postmedian fascia developed into a "comma-like" (similar to capreana). No median dash. Apical wing blotch white or grayish brown. If white, postmedian fascia with 2 irregularly shaped transverse bars; the more distal usually darker, shorter. Apex and termen brown. Specimens exhibiting white apical wing blotch have 9 pairs of narrow costal strigulae: 2 pairs faint light brown on basal, postbasal, median, and 3 white pairs on outer 1/3 of wing. Specimens lacking white apical wing blotch lack costal strigulation. Outer fringe light brown mixed with brown. Ventral surface

brown; white costal strigulae present; dorsal pattern visible through scales.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. In many specimens, this pattern is broken by irregular rows of transverse white maculation. Outer fringe light brown.

Legs: Pro- and mesothoracic legs dark brown; white banding on distal apex of tibiae and tarsomeres present or absent. Metathoracic legs white.

Abdomen: Uniformly dark brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight; ventral margin of sacculus round; outer margin of digitus slightly concave at base, apex round. Spine cluster moderately dense. Spines long, thin, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Ostium ovate; sterigma sagittate. Ductus moderately reticulate posteriorly; central part curles and bulbous, partially extends anterior to 7th sternite.

Hosts: Alnus motlis, (taken from pinned specimen).

Specimens Examined: Paratypes - 2 males, "I-12-38", slide catalogue no. 14306. L.E. Chadwick, slide temp. lost (MCZ). QUEBEC: Mt. Jacques,

Knob Lake; MANITOBA: Churchill; ALASKA: St. Paul Id.; Eagle Summit, 34.

Apotomis funerea (Meyrick) new Combination

(figs. 8, 15, 21, 34)

Argyroploce funerea Meyrick, 1920, Exotic Microlep., pt. II, 2:350.

Argyroploce youngana McDunnough, 1922, Can. Ent. 54:41.

Olethreutes youngana Forbes, 1923, mem 68, Cornell Univ. Agr. Exp. Sta., p. 455.

Aphania youngana Heinrich, 1926, Rev. No. Amer. moths of the subfamilies Laspeyresiinae and Olethreutinae. U.S. Nat. Mus. Bull. 132. pls. 45 and 62, p. 116.

Aphania funerea Clarke, 1958, Cat. type specimens in Brit. Mus. (Nat. Hist.) described by Edward Meyrick, p. 300.

Diagnosis: Forewing pattern separates this species from all Apotomis, except for A. bifida and A. brevicornutana which requires comparison of male genitalia. A. funerea is much more commonly collected than the mentioned two species.

Head: Vertex brown mixed with white; palps, basal 1/2 white, distal 1/2 dark brown. Male flagellum 38-48 flagellomeres (N=10), female 39-47 (N=11).

Thorax: Mesothorax and tegulae dark brown mixed with white, the former possessing a distinct dark brown

transverse median band. Grayish brown beneath.

Forewings: Alar expanse: male, 8.03-9.17 mm (N=20); female, 7.70-9.50 mm (N=21). Basal 2/3 of wing predominantly dark brown mixed with grayish brown. Basal and postbasal fasciae white mixed with brown; usually incomplete. Median fascia cannot be recognized. Median dash usually present. Apex and termen brown. Postmedian fascia possessing 2 irregularly shaped transverse bars, the most distal bar is usually darker, shorter; occasionally containing 2-3 minute dark brown dots or lines. Median inflection blunt. Nine pairs of costal strigulae present: 2 pairs faint white on basal, postbasal median fascia, 3 white pairs on apical 1/3 of wing. Outer fringe light brown except at tornus which is white. Ventral surface brown; white costal strigulae present, dorsal pattern visible through scales.

Hindwings: White at base, darkening gradually toward apex and outer margin. Outer fringe light btown. Brown maculations present from inner margin to apex.

Legs: Pro- and mesothoracic legs dark brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Dorsal surface light brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight or curved; lower margin

of sacculus round; digitus wider at base than at apex, outer margin convex, apex round; spine cluster dense. Spines stout, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Ostium "tear-shaped"; sterigma sagittate. Ductus moderately reticulate posteriorly, central part curled and bulbous, extends anterior to 7th sternite.

Hosts: Betula, Salix, Alnus, Corylus, (Prentice 1965).

Specimens Examined: Photographs of Lectotype designated by Clarke (1958) - male, Toronto, Canada. Parish - 7 - 12. Slide no. 7340. In British Museum. A. youngana, Holotype - male QUEBEC: Meach Lake, 20, VII-06, C.H. Young, Series no. 284. Slide 2. Paratypes - Female ONTARIO: Ottawa, 6-VII-1905, C.H. Young, series no. 284; 4-VII-1905, 25-VII-1905, 11-VII-1905, 11-VII-1905; Female - QUEBEC: Chelsea, 16-VII-1012, unknown collector. ALBERTA: Edmonton, MANITOBA: Gillam; NOVA SCOTIA: Armdale, Halifax, Hectanooga, Victoria Co., Watershed; ONTARIO: Bobcaygeon, Black Sturgeon Lake, Madue, Minaki, Nipigon, One-Sided Lake, Ottawa, Thunder Bay, Toronto, W.

Richmond; CONNECTICUT: Granby, Putnam, Windham; MASSACHUSETTS: Martha's Vineyeard; MAINE: Bar Harbor, Mt. Desert Is., Rockport, Southwest Harbor; MICHIGAN: Midland Co.; MINNESOTA: Duluth; NEW HAMPSHIRE: Randolph; NEW YORK: Clayton, Pelham; NORTH DAKOTA: Cass Co.; WASHINGTON: Berne; WISCONSIN: Door Co., Oneida Co. - 282.

Apotomis infida Heinrich, new combination

(figs. 5, 9, 31, 40)

Aphania infida Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae. U.S. Nat. Mus. Bull. 132, pl. 45 and 64, p. 121-122.

Diagnosis: This species can be separated from most Apotomis by forewing pattern, except for specimens of coloradensis, trifida, and spurinfida. In the latter cases examination of male genitalia slides is necessary.

Head: Most scales on vertex grayish brown tipped with white; basal 1/4 of palps white, distal 3/4 grayish brown. Male flagellum 42-48 flagellomeres (N=3), female 42-43 (N=2).

Thorax: Mesothorax and tegulae with majority of scales grayish brown tipped with white. Mesothorax with dark brown transverse median band. White beneath.

Forewings: Alar expanse: Male 4.93-9.23 mm (N=10), female

8.05-9.77 mm (N=10). No white apical wing blotch. Median inflection not distinct. Postbasal fascia flanked by darker basal and median fasciae. Basal fascia complete median fascia incomplete, narrowed posteriorly, abruptly terminating on median dash. Seven pairs of light brown costal strigulae present: 2 pairs on postbasal and median fascia, 3 pairs on apical 1/3 of wing. Postbasal strigulae large and distinct; distal pairs progressively reduced in size. Basal strigulae usually absent. Postmedian fascia with 2 irregularly shaped transverse bars; the most distal bar is usually darker and contains 2-3 minute dark brown dots or lines. Outer fringe light brown or white. Ventral surface light brown; white costal strigulae present, medial veins streaked with white distally. Postbasal strigulae large, progressively reduced in size.

Hindwings: White at base, gradually darkening toward apex and outer margin. Outer fringe white. Ventral surface with faint brown maculations at apex.

Legs: Pro- and mesothoracic legs grayish brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Light brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus slightly curved; ventral margin of sacculus highly angular; outer margin of digitus convex, apex broad, slightly rounded. Spine cluster dense. Spines long, thin, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Ostium circular; sterigma reduced, in 2 parts - each lateral to ostium. Posterior part of ductus sclerotized, reticulation absent; central part curled and linear, anterior to 7th sternite.

Hosts: Salix spp. (from pinned specimen).

Remarks: Holarctic distribution.

Specimens Examined: Holotype - male, QUEBEC: St. Therese Is., St. Johns Co., 9-VI-15, W. Chagnon. (USNM) Paratypes - ALBERTA: Calgary, 15-VII-1906, F.H. Wolley, series 1149 (CNC) slide no. 2; Nordegg, 27-VII-1921, McDunnough, slide no. 1, series 1149 (CNC); ONTARIO: Toronto, 9-VI-1911, Evans, slide no. 5, series 1149, (CNC). EUROPE. ALBERTA: Banff, Edmonton, Hillcrest, Nordegg; BRITISH COLUMBIA: Setun Lake. QUEBEC: Covey Hill; SASKATCHEWAN: Indian Lake; COLORADO: Doolittle Ranch, Mt. Evans, Park Co.; IDAHO: Mt. Gisborne; MAINE; NEW HAMPSHIRE; NEW YORK: Ithaca; WASHINGTON: Ferry Co. WYOMING: Sublette Co., - 36.

Apotomis paludicolana (Brower) new Combination

(figs. 28, 37)

Aphania paludicolana Brower, 1953, Ann. Ent. Soc. Amer. 46:95-96.

Diagnosis: Can be distinguished from other Apotomis by forewing pattern.

Head: Vertex grayish brown mixed with white; basal 2/3 of palps white, distal 1/3 grayish brown.

Thorax: Tegulae grayish brown mixed with white. Mesothorax greasy dark brown. Specimens not adequate for suitable description of thorax. Consult Brower (1953).

Forewings: Alar expanse: Male 6.66-6.75 mm (N=2), female 6.66-7.02 mm (N=2). Transverse white scale pattern on basal 1/2 of wing, pattern obliterated posteriorly by a white suffuse band (similar to albeolana) originating at midline of the base of the wing, between media and Cu branch of discal cell; not extending beyond ental apex of median dash. Median fascia incomplete. No other fasciae. Apical wing blotch median inflection prominent; bissects median dash. None pairs of faint strigulae present: 2 light brown pairs on basal, postbasal, median fascia, and 3 white pairs on outer 1/3 of wing. Apex and termen light brown. Postmedian fascia with 2

irregularly shaped transverse bars; distal bar usually darker and shorter. Outer fringe white. Ventral surface light brown; costal strigulae present; lightly streaked with transverse brown maculations. Dorsal pattern visible through scales.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. Outer fringe white. Ventral surface white.

Legs: Pro- and mesothoracic legs dark brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Uniformly greasy grown.

Male Genitalia: Cornutus straight; ventral margin of sacculus round; outer margin of digitus convex, apex round. Spine cluster dense. Spines stout, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Ostium sub-ovate with apex elongate; sterigma sagittate. Ductus slightly reticulate; central part curled and bulbous, anterior to 7th sternite.

Hosts: Myrica gale, (Brower 1953).

Specimens Examined: Holotype - male, MAINE: Southwest Harbor, 12-VII-1937. In A.E. Brower Collection (to be deposited in CNC). Paratypes - female MAINE: Southwest Harbor, 8-VI-1937. (to

be deposited in CNC). 1 male, MAINE: Southwest Harbor, 12-VI-1937, A.E. Brower Collector; 1 female, same locality, 8-VI-1937. A.E. Brower Collector. NEW BRUNSWICK: 2 male; MAINE: 1 male, Oguossoc; 1 female, Seboonook. - 12.

Apotomis removana (Kearfott) new Combination

(figs. 18, 44)

Olethreutes removana Kearfott, 1907, Trans. Amer. Ent. Soc. 33:15 Forbes, 1923, Mem 68, Cornell Univ. Agr. Exp. Sta., p. 453.

Argyroploce removana Barnes & McDunnough, 1917, Check List Lepid. Bor. Amer. No. 6860, p. 168.

Argyroploce dextrana McDunnough, 1923, Can. Ent. 55:165.

Aphania removana Heinrich, 1926, pl. 44 & 64, p. 122-23.

Aphania dextrana Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laypeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pl. 65, p. 121. New synonmy.

Diagnosis: Much variability in forewing pattern exists within this species. It is quite distinct from other Apotomis.

Head: Most scales on vertex grayish brown, tipped with white; mesothorax with dark brown transverse median band.

Forewings: Alar expanse: Male 7.90-9.77 mm (N=20),

female 7.95-10.95 mm (N=20). No white apical wing blotch. Median inflection not evident. Fasciae sometimes incomplete. Subbasal fascia brownish gray; laterally flanked by darker basal and median fasciae. Median fascia narrowed posteriorly, continuing beyond media vein, terminating before or on posterior margin. No median dash. Nine pairs of light grayish brown strigulae present: 2 pairs on basal, postbasal, median fascia, and 3 pairs on apical 1/3 of wing. Postbasal strigulae large; successive pairs gradually reduced in size. Basal strigulae faint. Postmedian fascia with 2 irregularly shaped transverse bars. Outer fringe alternately streaked with dark brown and light brown scales, tipped with white. Ventral surface light grayish brown, white between CuA_2 and posterior margin; white costal strigulation present. Extensive variation. Specimens represent a continuum from "calico" to "smudged" scale patterns. The "calico" pattern is exhibited by specimens possessing scales with dark bases and white tips. "Smudged" patterns are exhibited by specimens possessing scales with gray bases with little white on their tips. Intermediates common. Variants summarized by Miller (1979). These morphs result from adjacent fasciae or wing areas bearing scales

with contrasting magnitudes of color (i.e., light, intermediate, dark) or adjacent fascia or wing areas possessing only dark monocolored scales.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. Outer fringe scales white. Ventral surface white or light brown abruptly darkening at apex and outer margin.

Legs: Pro- and mesothoracic legs grayish brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Light brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight; ventral margin of sacculus round; outer margin of digitus strongly convex at base, slight concavity toward apex. Apex round. Spine cluster dense. Spines stout, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Ostium "tear-shaped"; sterigma sagittate. Posterior portion of ductus moderately reticulate; central part curled and bulbous, anterior to 7th sternite.

Hosts: Populus tremuloides, (from pinned specimen).

Remarks: McDunnough (1923) states that "male genitalia are very similar to those of removana but the clasp-ers are considerably broader apically, the ventral

spined projection of the sacculus is longer and broader and the cornutus is noticeably longer and contains a slight lateral projection. Examination of a large series of dextrana and "removana" male genitalia preparations indicates that there is no consistency in McDunnough's claim. Female genitalia are identical.

Specimens Examined: A. removana, lectotype - male PENNSYLVANIA: New Brighton, 21-VIII-1904. H.D. Meyrick, series no. 4667, (cotype of Kearfott) A. dextrana, Holotype - male, ONTARIO: Ottawa, 28-VII-1906, C.H. Young Collector, series no. 595, slide no. 7. A. dextrana; paratypes - female, ONTARIO: Ottawa, 5-VIII-1906, C.H. collector, series no. 595, ALBERTA: Calgary, 27-VII-1915, F.H. Wholley collector, series 595 slide no. 7A. ALBERTA: Edmonton; BRITISH COLUMBIA; MANITOBA: Aweme, Churchill, NOVA SCOTIA: Baddeck; ONTARIO: Mer Bleue, Ottawa, Stittsville, Trenton, W. Richmond; QUEBEC: Montreal, Pincourt, Rapides; SASKATCHEWAN: Butland, Saskatoon; ARIZONA: Coconino Co.; CALIFORNIA: Mono Co., COLORADO: Gilpin Co., Mt. Evans; IDAHO: Salmon; INDIANA: Hessville; MAINE: Rangeley, Millinocket; MICHIGAN: Midland Co., NEW YORK: Clayton, Dryden, Fisher, Ithaca, New Russia, Oswego, Rochester, Thomkins

Co.; NEW MEXICO: Sandoval Co., Santa Fe; UTAH: Grand Co., San Juan Co., Utah Co.; VERMONT: No. Hero; WISCONSIN: Oneida Co.; WYOMING: Carbon Co., Fremont Co., Park Co., Pitkin Co., Routt Co., Sublette Co. - 344.

Apotomis spinulana (McDunnough) new Combination

(figs. 29, 42)

Aphania spinulana: mcDunnough, 1938, Can. Ent. 70:93-96.

Diagnosis: May be distinguished from other Apotomis by forewing pattern.

Head: Vertex predominantly grayish brown, mixed with white; basal 1/3 white, distal 2/3 grayish brown.

Thorax: Mesothorax and tegulae predominantly grayish brown, mixed with white. Mesothorax with dark brown transverse median band. White beneath.

Forewings: Alar expanse; male 8.17 mm (N=1), female 7.33-7.50 mm (N=2). Basal 2/3 of wing with mottled brown similar to tertiana. All fascia incomplete. Median fascia dark brown, narrowed posteriorly, terminating on median dash. Apex and termen dark brown, reducing apical wing blotch to only postmedian fascia. Postmedian fascia with 2 irregularly shaped transverse bars; distal bar usually darker and shorter, containing 2-3 minute dark brown dots or lines. Strigulation on basal 2/3 of wing indiscernible;

apical 1/3 of wing with 3 pairs of white strigulae. Median inflection pointing posteriorly, (similar to capreana); intersecting with distal end of median dash. Outer fringe brown, except at tornus which is white. Ventral surface light brown; white costal strigulae present; dorsal pattern visible through scales.

Hindwings: Light brown, gradually darkening toward apex and outer margin. Outer fringe white. Ventral surface white, possessing brown maculations at apex.

Legs: Pro-and mesothoracic legs brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus straight, occasionally spiraled ventral of sacculus moderately angular; outer margin of digitus convex, apex round; spine cluster dense. Spines stout, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Ostium ovate; sterigma semicircular. Posterior part of ductus sclerotized, reticulation absent; central part of ductus curled and bulbous; extends anterior to 7th sternite.

Hosts: Betula and salix, (Prentice 1965).

Specimens Examined: Holotype - male, MANITOBA: Churchill, 4-VII-1937. No slide no., series no. 4337, W.J.

Brown Collector (CNC). Paratype - female, MANITOBA: Churchill, 4-VII-1937. No slide no., series no. 4337, W.J. Brown collector (CNC). BRITISH COLUMBIA: 2 female clinton; ALASKA: 1 male, mile 250 of Alaskan highway. - 10 male 3 female, MANITOBA: Churchill, June 15, 17, 23; July 4, 9, 1937 W. J. Brown Collector, series 4337 (CNC) - 18.

Apotomis spurinfida Adamski, new Species

(fig. 25, 48)

Diagnosis: Can be distinguished from most Apotomis by forewing pattern, except for specimens of infida, trifida, and coloradensis, in the latter cases comparison of male genitalia slides is necessary.

Head: Most scales on vertex grayish-brown tipped with white; basal 1/3 of palps white, distal 2/3 brown.

Thorax: Mesothorax and tegulae with majority of scales grayish brown tipped with white; poor condition of specimens prohibits further thoracic description.

Forewings: Alar expanse: Male 8.16-10.33 mm (N=4). White apical wing blotch absent. Median inflection not evident. Postbasal fascia laterally flanked by darker basal and median fasciae. Basal fascia incomplete. Median fascia incomplete; narrowed posteriorly, abruptly terminating on median dash.

Seven pairs of faint light brown strigulae present: 2 pairs on postbasal and median fascia, and 3 pairs on apical 1/3 of wing. Postbasal strigulae large and distinct; successive distal pairs progressively smaller. No basal strigulae. Subapical area and termen light brown. Postmedian fascia with 2 irregularly shaped transverse grayish brown bars. Outer fringe light brown. Ventral surface brown; white costal strigulation present, all veins streaked with white distally.

Hindwings: Light brown at base gradually darkening toward apex and outer margin or as above with brown transverse maculations. Outer fringe white. Ventral surface uniform light brown or heavily maculated with irregularly shaped transverse maculations.

Legs: Pro- and mesothoracic legs grayish brown, with white banding in distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus bifid; ventral margin of sacculus slightly angular; outer margin of digitus convex, apex round. Spine cluster dense. Spines stout, spatulate. Cucullus strongly produced vertically.

Female Genitalia: Female unknown.

Hosts: Unknown.

Specimens Examined: Holotype - Male, CALIFORNIA: Sagehen

nr. Hobart Mills, 21-VII-62, J.R. Stewart collector, D. Adamski genitalia slide no. 519, (EEM). Paratypes - 1 male, CALIFORNIA: Mono. Co. nr. Tom's Place, 10-VIII-1964, J.D. Birchim and C.D. MacNeil collectors, D. Adamski genitalia slide no. 551 (CAS). OREGON: 1 male, Lake Co., 10 mi. Silver Lake, 23-VII-66; J. Powell collector, D. Adamski genitalia slide no. 569 (EEM). WASHINGTON: 1 male, Pullman, Wash. Expt. Sta. No. 400, C.V. Piper collector, Kearfott coll. Ac. 4667, originally identified as Olethreutes deceptana Kearfott. D. Adamski genitalia slide no. 522 (AMNH). - 4.

Apotomis tertiana (McDunnough) new Combination

(figs. 27, 36)

Argyroploce tertiana McDunnough, 1922, Can. Ent. 54:42.

Olethreutes tertiana Forbes, 1923, memoir 68, Cornell Univ. Agr. Exp. Sta., p. 455.

Aphania tertiana Heinrich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132, pl. 63, p. 117.

Aphania strigosa Henirich, 1926, Rev. No. Amer. moths of subfamilies Laspeyresiinae and Olethreutinae, U.S. Nat. Mus. Bull. 132 pl. 65, p. 118. New synonmy.

Diagnosis: Closest to afficticia in forewing pattern.

However, separation can be made by examination of male and female genitalia slides. Comparison of the male holotype of strigosa with that of tertiana (including a modest sized series of the latter) indicates that they are synonymous.

Head: Vertex uniform brown occasionally mixed with white; basal 2/3 of palps white, distal 1/3 brown.

Thorax: Tegulae brown mixed with white, with a characteristic dark brown elongate scale pattern on base of inner margin. Mesothorax brown mixed with white possessing a dark brown median transverse band. Infrequently white with a dark brown transverse median band. White beneath.

Forewings: Alar expanse; male 6.72-8.25 mm (N=6), female 6.89-7.45 mm (n=6). Basal 2/3 of wing mottled browns and white. Fasciae complete, incomplete, or absent altogether. Subapical area and termen dark brown, reducing apical wing blotch size. Postmedian fascia usually with 2 irregularly shaped transverse bars; the most distal bar usually darker, shorter; containing 2-3 minute dark brown dots or lines. Nine pairs of narrow costal strigulae present: 2 faint light brown pair on basal, postbasal, median fascia, and 3 white pair on outer 1/3 of wing. Strigulation is retained in specimens where wing fasciae

are altogether absent. Outer fringe brown, except at tornus which is white. Ventral surface brown; white costal strigulation present; dorsal pattern visible through scales.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. Outer fringe white. Ventral surface white or light brown possessing brown maculations at apex.

Legs: Pro- and mesothoracic legs dark brown with white banding on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Abdomen: Uniform brown with no contrasting colors dorsally or ventrally.

Male Genitalia: Cornutus straight or curved toward apex; ventral margin of sacculus round; outer margin of digitus convex, apex round. Spine cluster moderately dense. Spines long, thin, spatulate. Cucullus weakly produced vertically.

Female Genitalia: Ostium ovate; sterigma semicircular. Ductus moderately reticulate posteriorly; central part curled and bulbous, part extends anterior to 7th sternite.

Hosts: Betula papyrifera (from pinned specimen); Salix and Acer, (Prentice 1965).

Specimens examined: A. tertiana, Holotype - Male ONTARIO:

Ottawa, Series 286, C.H. Young Collector (CNC).
A. strigosa, Holotype - male ALASKA: Dawson, 16-VI-1916 (specimen mounted backwards on slide), (USNM). ONTARIO: Black Sturgeon Lk.; Biscotasing; One-Sided Lk, Missanabi; Baspe; ALBERTA: Edmonton; QUEBEC: Laniel, 10.

Apotomis trifida Adamski, new Species

(figs. 3, 22, 46)

Diagnosis: Can be distinguished from most Apotomis by forewing pattern, except for specimens of infida, spurinfida, and coloradensis. In the later cases comparison of male genitalia slides is necessary.

Head: Most scales of vertex grayish brown tipped with white; basal 1/4 of palps white distal 3/4 grayish brown.

Thorax: Mesothorax and tegulae with majority of scales grayish brown tipped with white. Mesothorax with transverse dark gray median band. White beneath.

Forewings: Alar expanse: Male 9.40 mm (N=1). All fascia present. No white apical wing blotch. Median inflection not evident. Postbasal fascia flanked by darker basal and median fasciae. Median fascia narrowed posteriorly, more so than infida; continuing beyond median dash; terminating at a light brown irregularly shaped marking. Seven pairs of faint

strigulae present: 2 pairs on postbasal and median fascia, 3 pairs on apical 1/3 of wing. Postbasal strigulae large and distinct; distal pairs progressively reduced in size. No basal strigulae. Distal 1/3 of wing light brown. Postmedian fascia possessing 2 irregularly shaped transverse grayish brown bars. Outer fringe light brown. Ventral surface brown; white costal strigulae present; medial veins streaked white distally.

Hindwings: Light brown at base, gradually darkening toward apex and outer margin. Outer fringe light brown. Ventral surface uniform light brown.

Legs: Pro- and mesothoracic legs grayish brown, banded with white on distal apex of tibiae and tarsomeres. Metathoracic legs white.

Male Genitalia: Cornutus trifid; ventral margin of sacculus round; outer margin of digitus slightly convex, apex round. Spine cluster dense toward apex. Spines long, thin and spatulate. Cucullus strongly produced vertically.

Female Genitalia: Female unknown.

Hosts: Unknown.

Specimens Examined: Holotype - unique male, WASHINGTON: Ferry Co., Sherman Pass, 5,600 ft., 23-VII-1962, J.F.G. Clarke collector, D. Adamski genitalia slide no. 532 (USNM No. 80, 075). - 1.

Plate 1. Figs. 1-15. - 1, cucullus of A. deceptana (ental view). 2, cucullus of A. frigidana (ental view). 3, expanded lower margin of cucullus of A. trifida (ental view). 4, spine cluster (Spc_1) of A. afficticia (ental view). 5, spine cluster (Spc_1) of A. infida (ental view). 6, spine cluster (Spc_1) of A. capreana (ental view). 7, digitus of capreana. 8, digitus of A. funerea (ental view). 9, digitus of A. infida (ental view). 10, digitus of A. albeolana (ental view). 11, ventral margin of sacculus of A. apateticana (ental view). 12, ventral margin of sacculus of A. afficticia (ental view). 13, sterigma of A. apateticana, (ventral view). 14, sterigma of A. albeolana (ventral view). 15, sterigma of funerea (ventral view).


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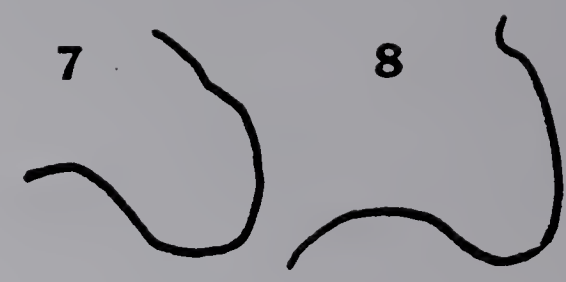
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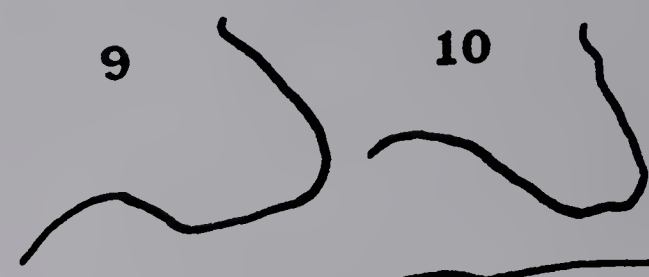
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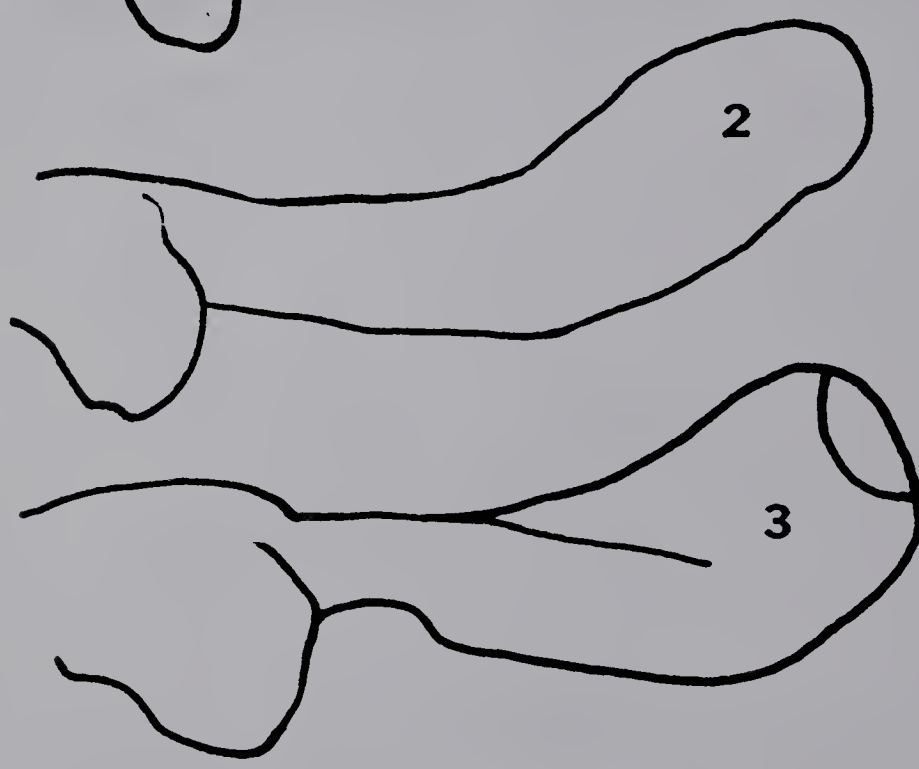
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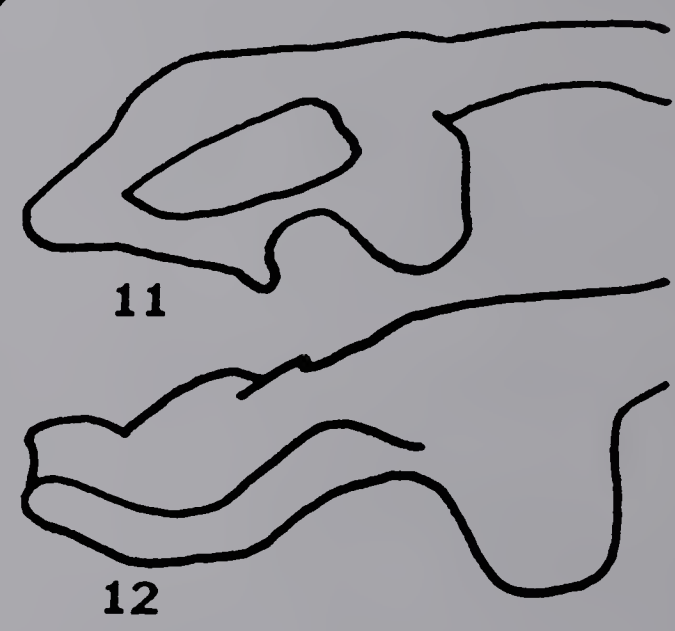
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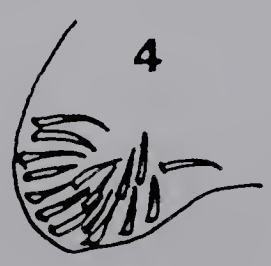
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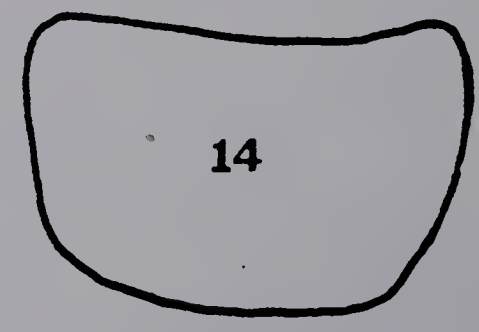
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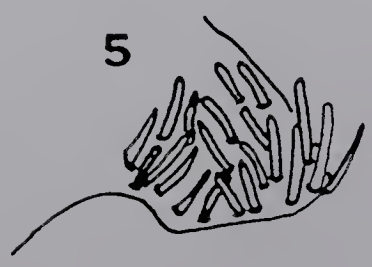
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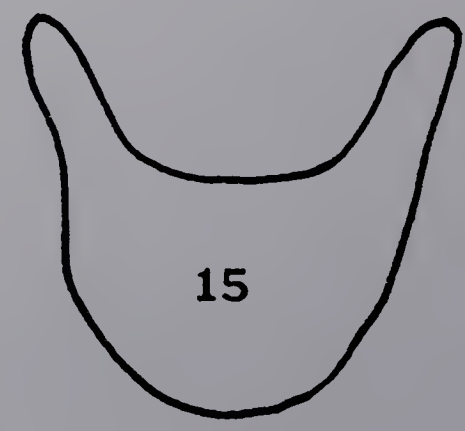
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Plate 2. Figs. 16-18. - 16, generalized scale pattern of forewing of Apotomis (dorsal view). 17, Holotype: male genitalia of A. coloradensis. 18, male genitalia of A. removana.

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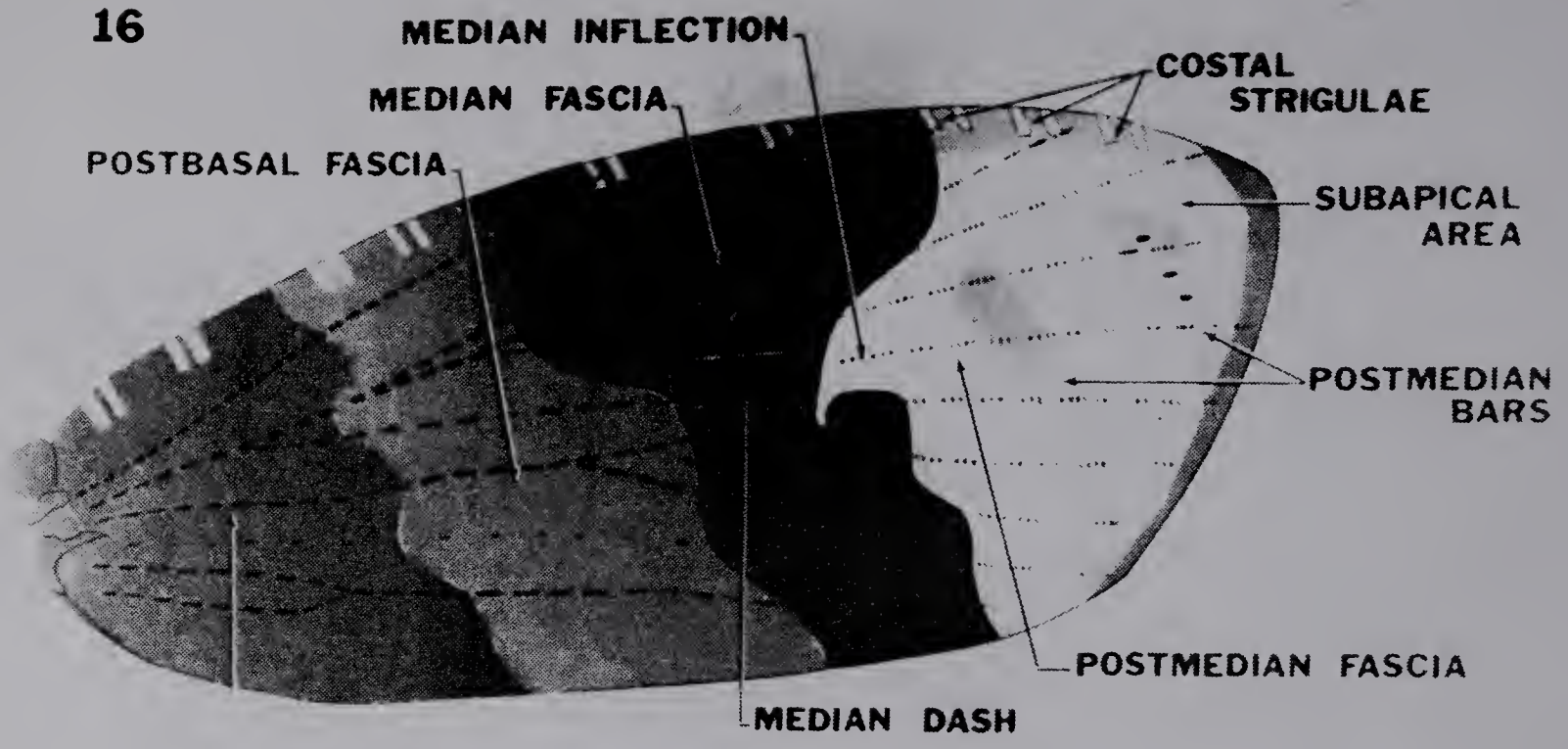
MEDIAN INFLECTION
MEDIAN FASCIA
POSTBASAL FASCIA
COSTAL STRIGULAE
SUBAPICAL AREA
POSTMEDIAN BARS
POSTMEDIAN FASCIA
MEDIAN DASH
BASAL FASCIA

17

18

Plate 3. Figs. 19-23. - 19, male genitalia of A. deceptana. 20, Holotype: male genitalia of A. afficticia. 21, male genitalia of A. funerea. 22, Holotype: male genitalia of A. trifida. 23, Male genitalia of A. frigidana.

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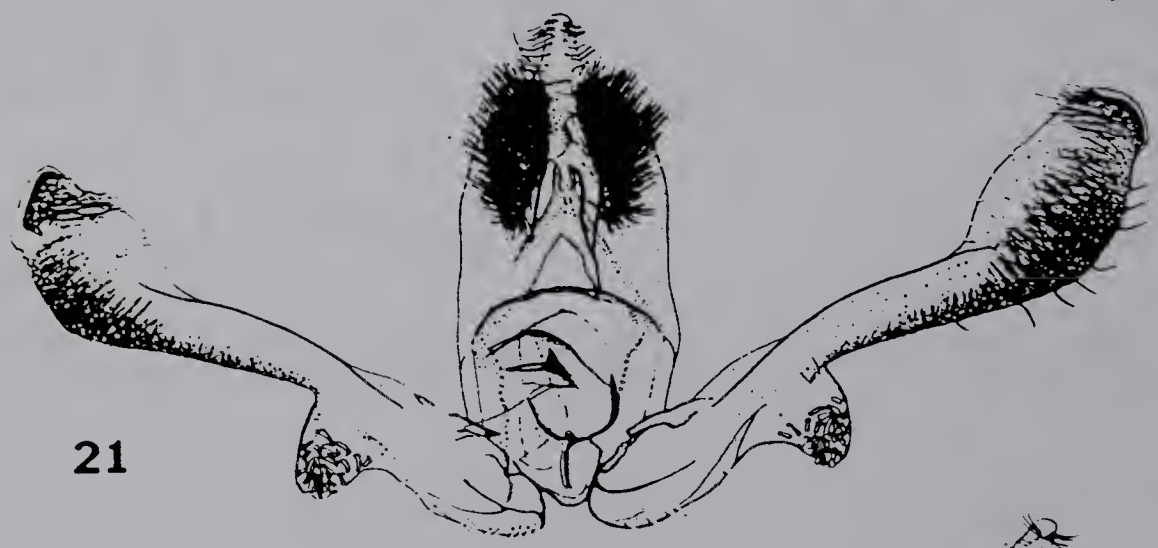

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Plate 4. Figs. 24-27. - 24, male genitalia of A. capreana. 25, Holotype: male genitalia of A. spurinfida. 26, Holotype: male genitalia of A. bifida. 27, male genitalia of tertiana and dissected aedeagus.

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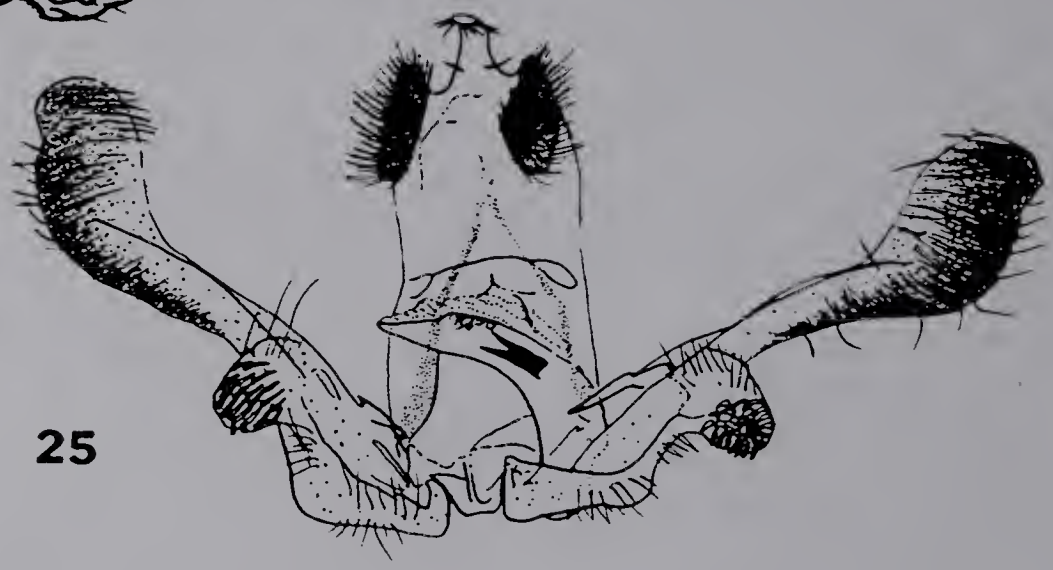

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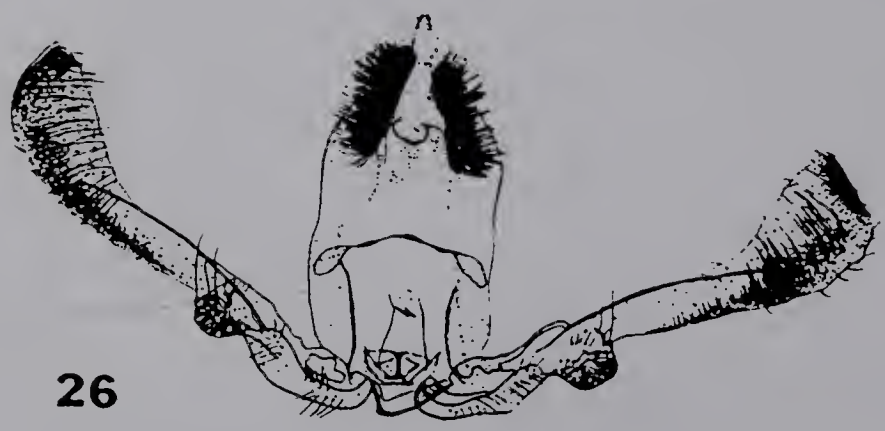

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Plate 5. Figs. 28-31. - 28, male genitalia of A. paludicolana. 29, Paratype: male genitalia of A. spinulana. 30, male genitalia of A. albeolana. 31, male genitalia of A. infida.

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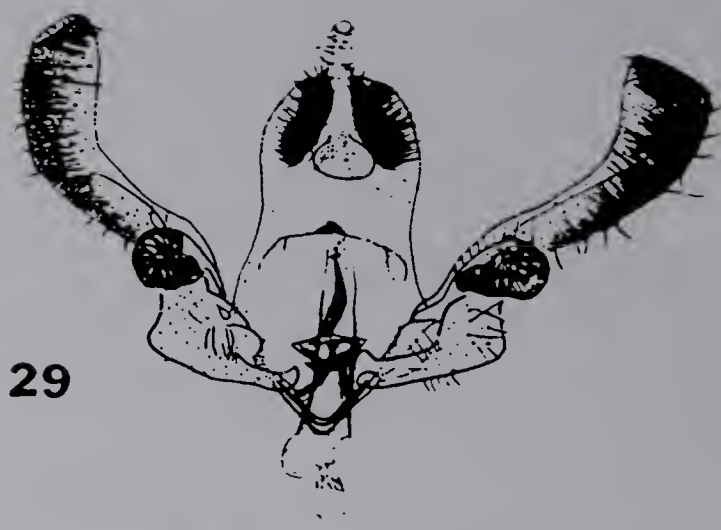

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Plate 6. Figs. 32-36. - 32, Holotype: male genitalia of A. brevicornutana. 33, male genitalia of A. apateticana. 34, female genitalia of A. funerea. 35, Paratype female genitalia of A. bifida?. 36, female genitalia of A. tertiana.

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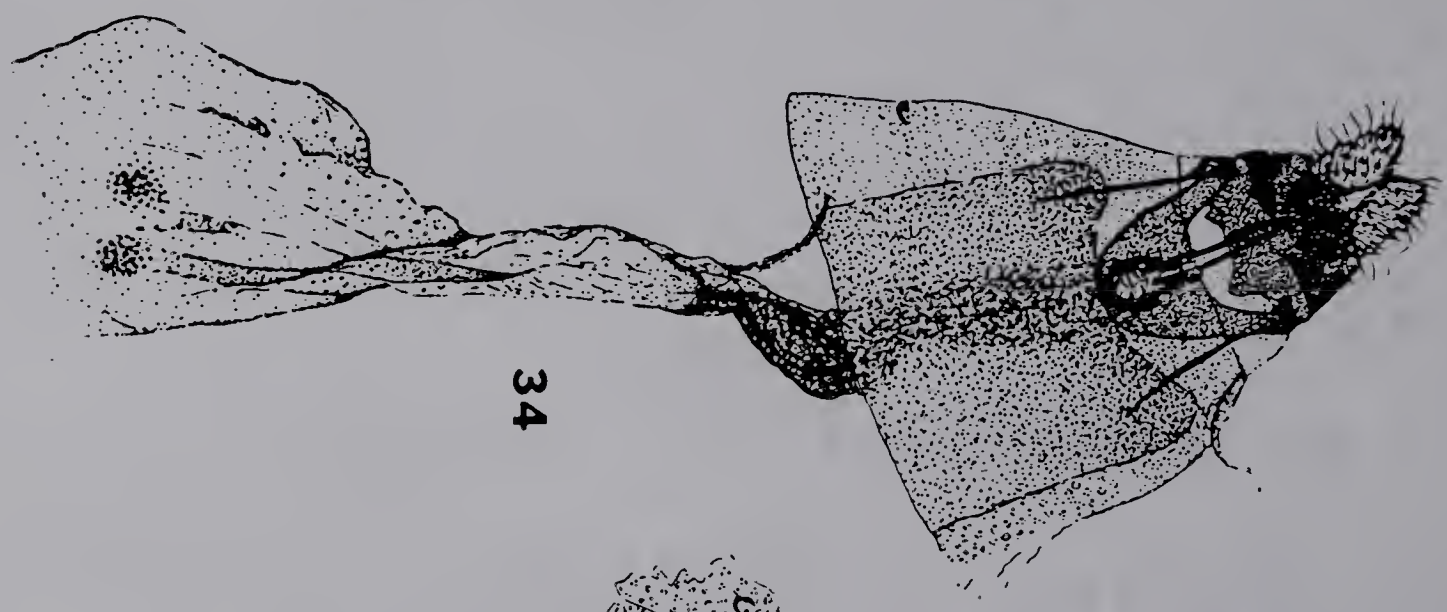

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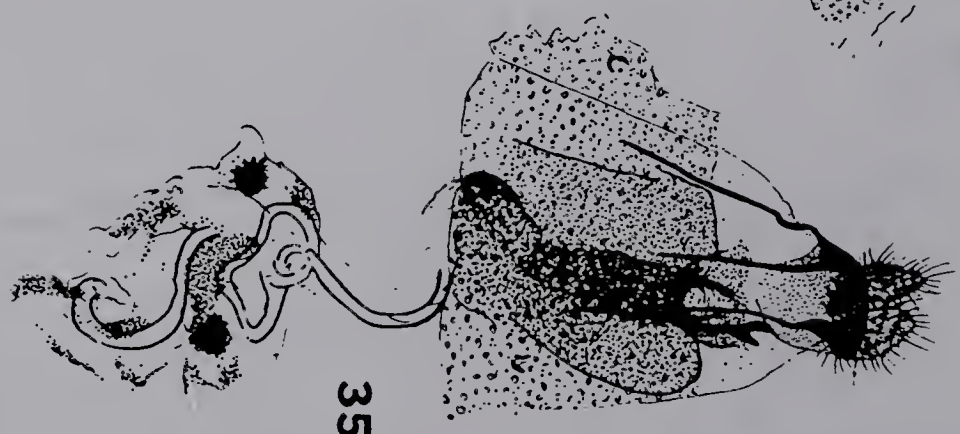

35

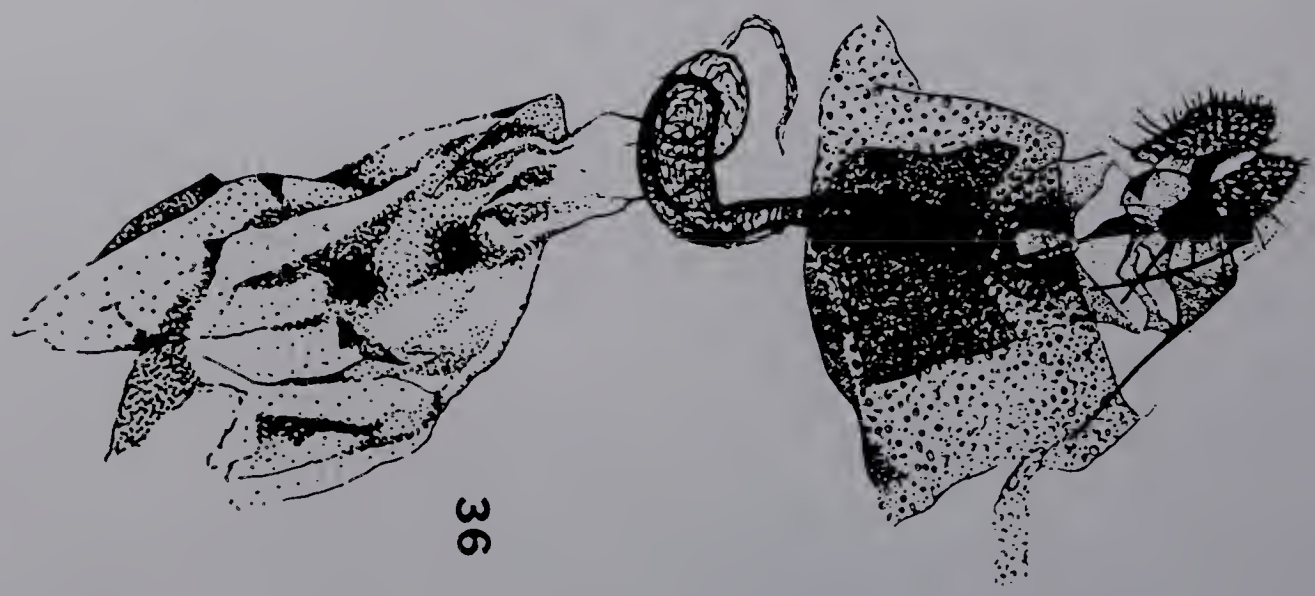

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Plate 7. Figs. 37-39. - 37, female genitalia of A. paludicolana. 38, female genitalia of A. deceptana. 39, female genitalia of A. albeolana.

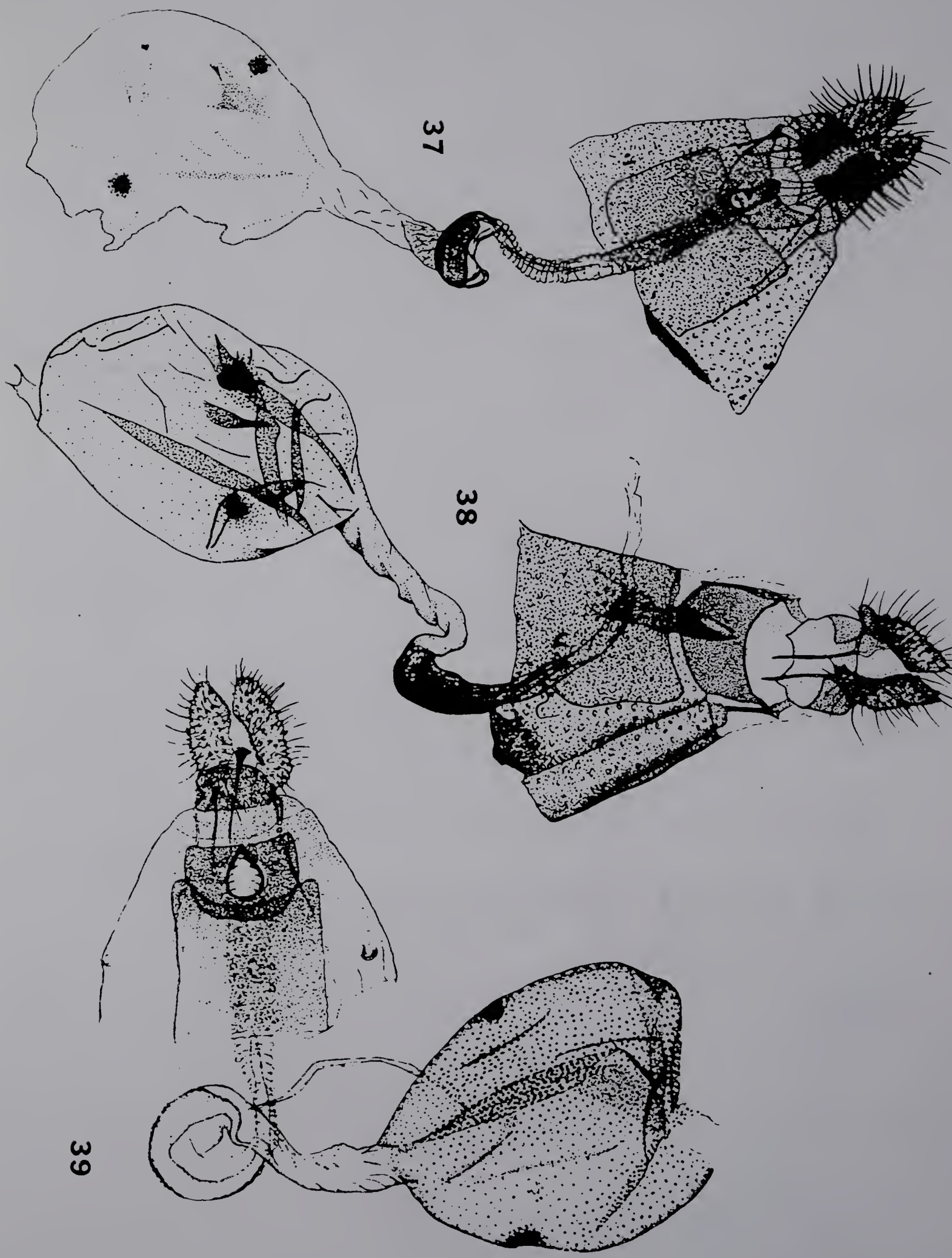

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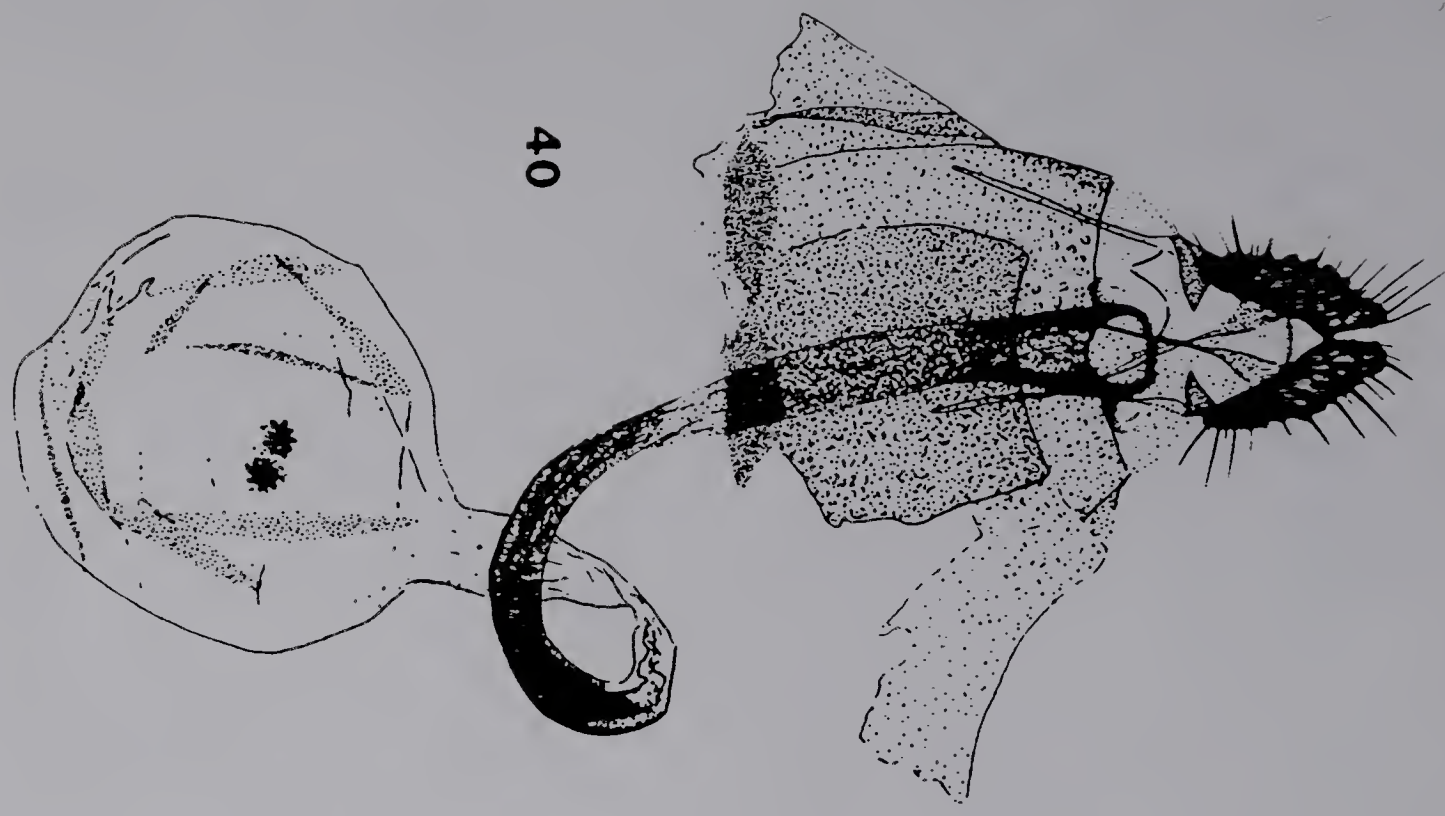
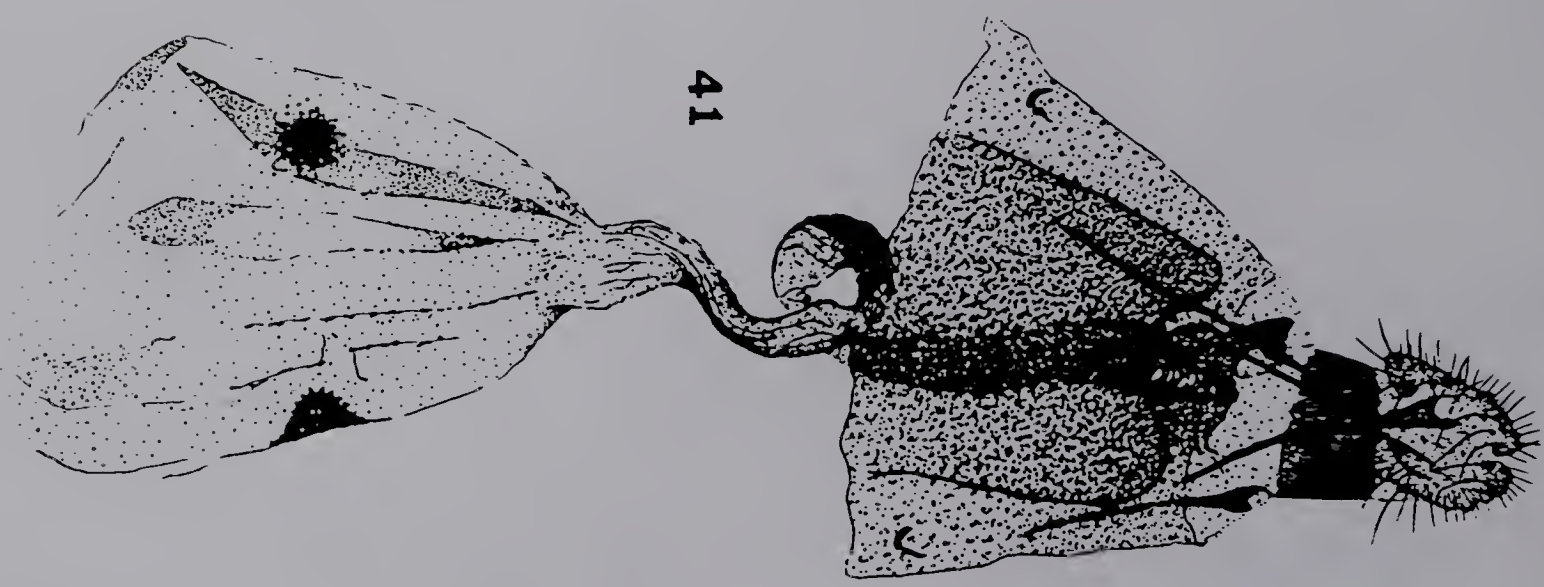
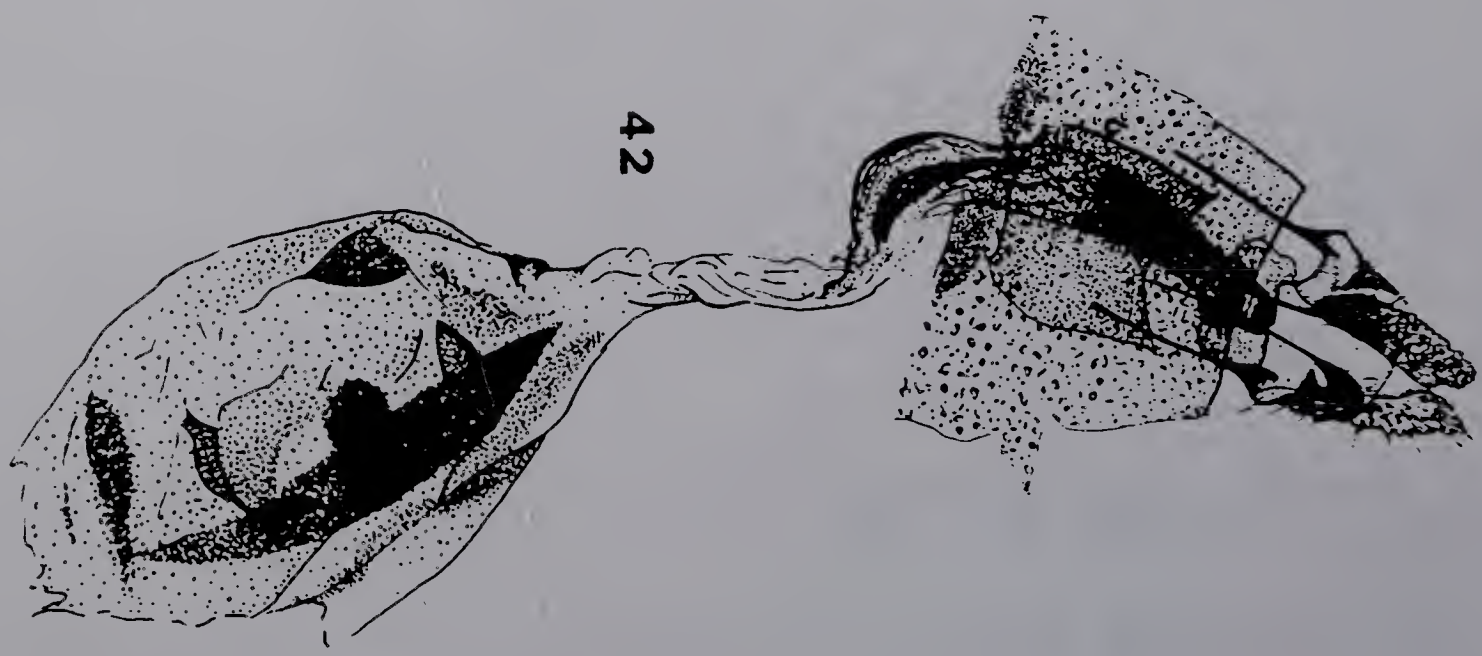
Plate 8. Figs. 40-42. - 40, female genitalia of A. infida. 41, female genitalia of A. capreana. 42, female genitalia of A. spinulana.



40

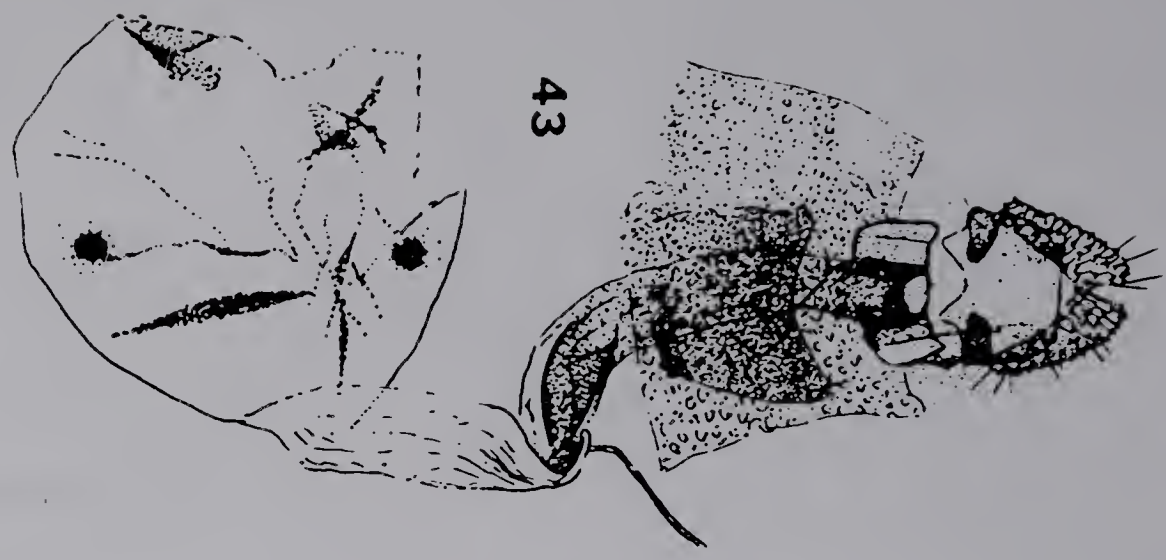


41



42

Plate 9. Figs. 43-45. - 43, female genitalia of A. apateticana. 44, female genitalia of A. removana. 45, female genitalia of A. frigidana.



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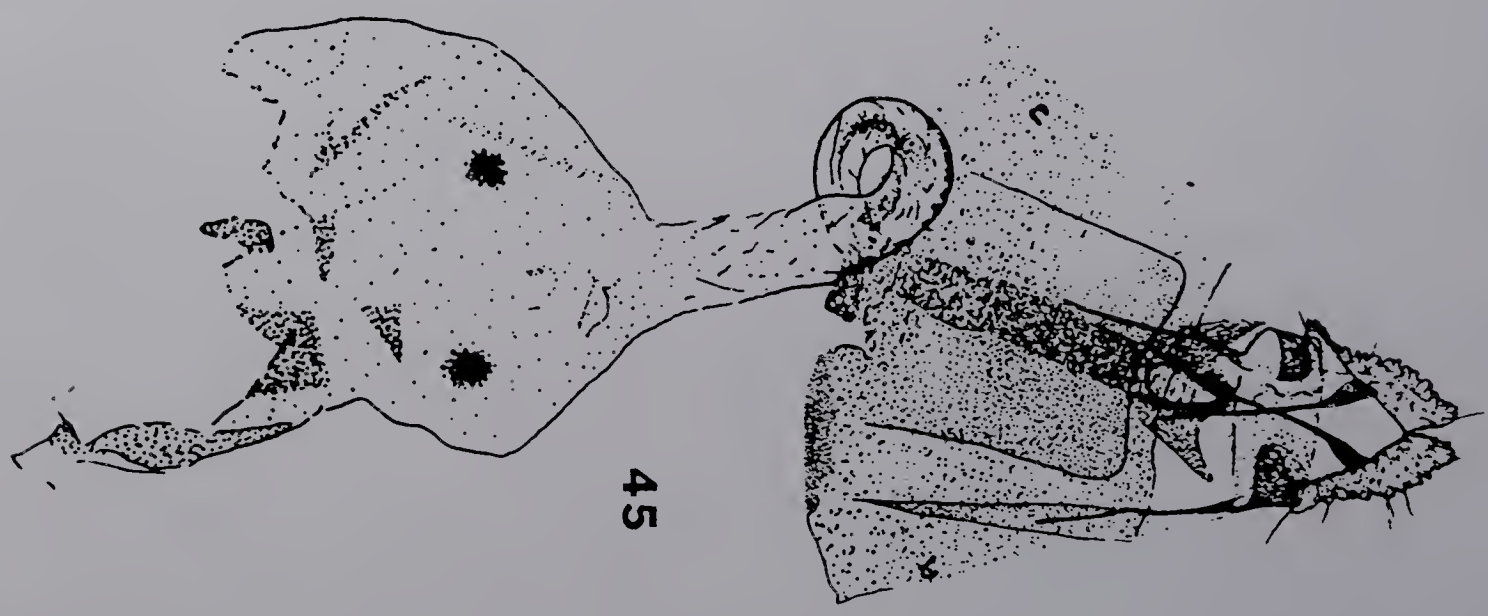

45

Plate 10. Figs. 46-48. - 46, Holotype of A. trifida. 47, Holotype of A. coloradensis. 48, Paratype of A. spurinfida.

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48

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